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Ford Builds a V-8

Machining the cylinder block requires new tooling and many striking departures from previous practice

WHEN Ford brings out a new design, industrial history is made. Thousands of workers the world over are directly engaged in machining and assembling the new product. Thousands of others, who are employed in the fabrication of purchased parts and materials, immediately feel the stimulus of activity at River Rouge.

As the leading advocate of low-cost automotive transportation, Ford's activities have greatly influenced economic and social conditions. Distances have diminished, new highways have opened, a new concept of transportation has evolved. So a new Ford is not merely another model but another milestone in this age of industrial progress. Model A succeeded the long-lived Model T, and now we see another change even more revolutionary—the introduction of the V-8.

Those who planned the new Ford had a tremendous responsibility to shoulder. Upon their judgment rested the progress of a great industry, the welfare of thousands of coworkers, the betterment of business in general and the satisfaction of the users of their output. Steps in research, design and production had to be made with exceeding care. Small errors have a way of growing into larger ones and must be caught early to avoid heavy losses in time and money.

As an example of one of the production problems tackled and solved by Ford's tool engineers, let us look at the heart of the new Ford, the V-8 cylinder block. Here is a unit unique in the annals of automotive design, an 8-cylinder engine in the lowest-price class. The machining of this block involves some unusual difficulties calling for careful planning and the generous use of mechanical ingenuity.

As in previous Ford models and responsible for their success, design and production of the V-8 are closely

Fig. 1—Drilling the main-bearing bolt holes is an important operation because two of the end holes serve as locating points for other operations

interlinked. Wherever possible, connecting machine elements have been eliminated, thus increasing the number of operations required. For example, the cylinder block casting is extended at the rear to include the flywheel housing. Both banks of cylinders are cast in one block which comprises the upper part of the crankcase as well. Bolts and bosses are thus reduced to a minimum, making a more economical unit to machine and to assemble. Because of its extreme simplicity, the V-8 gives promise of better service. Weight and space are conserved, and accurate alignment of cylinders and bearings is built into the motor. The location of the valve chambers above the cylinders, separated from the crankcase by a thin wall, places the valves in the most accessible position.

Another departure in design is of interest. In order to locate the main bearing caps, two tongues on each cap mate with grooves in the cylinder blocks. But instead of the conventional practice of making these tongues parallel to the crankshaft axis, they are made in circular arcs whose center coincides with the center of the bearing. When assembled, the caps align themselves with the crankshaft, automatically insuring a perfect fit. Only three exhaust ports are used on each side of the engine, the center one serving two cylinders.

Many Operations in One

A special mix electric-furnace cylinder iron is used for the block which weighs 180 lb. in the rough. The hardness of the cylinder bore is held within narrow limits. Fifty machining operations must be performed, all of them in exact relation to each other and to the walls of the casting. Each of these steps is not a single operation, as conceived in the ordinary machine shop, but a multiplicity of machine jobs completed successively or simultaneously, as for instance Operation 36, in which 83 holes are drilled in five different directions. Since the eight cylinders have $\frac{3}{16}$ in. walls, it is imperative that the casting be so positioned that foundry variations are equalized and minimized. Two new angles must be taken care of because of the V construction.

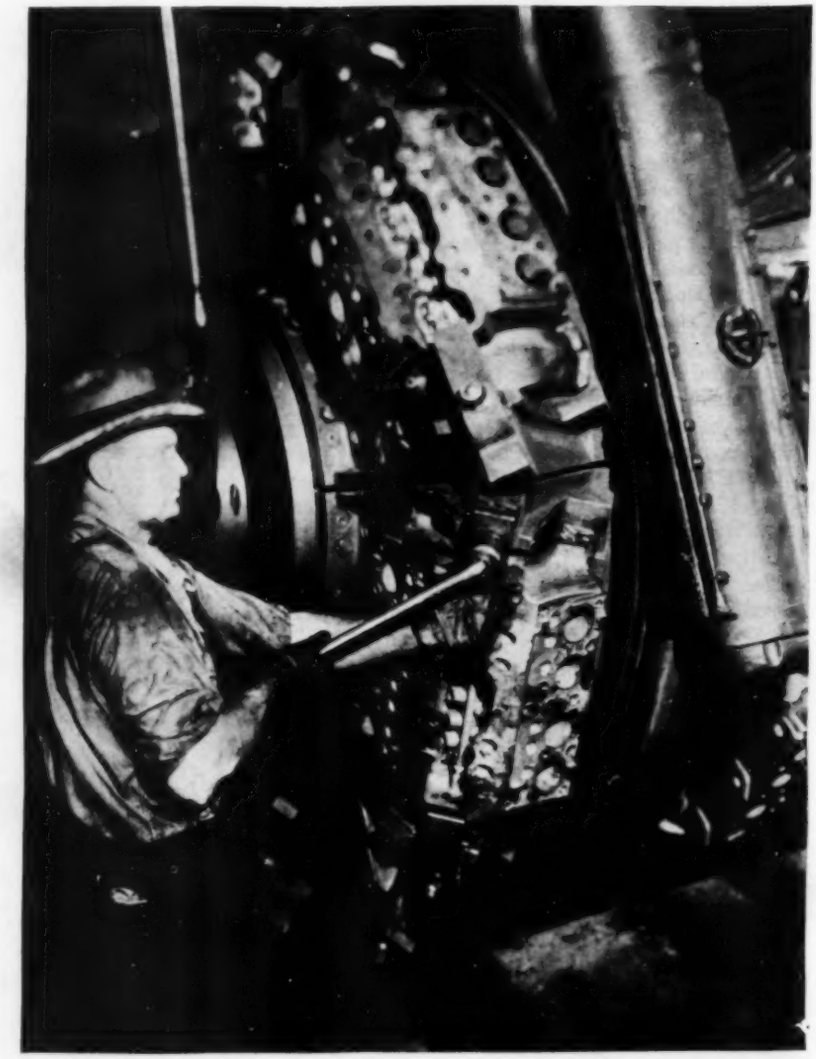
Despite these exacting conditions, operations have been so combined and the location of the castings in the fixtures so arranged that the V-8 block is now being machined in fewer steps than were formerly required for the Model A. To devise the tooling for this motor on the basis of 3,000 units every sixteen hours was no mean job.

The first machining operation is performed between the foundry and main machine floor. It consists in milling four locating pads on each cylinder bank. The operation is done in a Ford design two-head mill with the heads set at an angle of 90 degrees. For positioning the rough castings, the block is supported at the four corners. Two of the points of support are connected by an equalizing yoke which gives the set-up the effect of a three-point suspension. The casting is pushed on a drop table, which when lowered, leaves the block supported as described. Side location is obtained by four cam-operated fingers at the base. The casting is held firmly in place by a screw operated swing arm clamp at the top.

The blocks are transferred to the conveyor section shown at the upper left of the first layout diagram. The handling system consists of 22 continuous conveyors upon which the blocks travel. In general, the machine tools are placed between two consecutive conveyors. The blocks are passed through the successive operations by removing them from one conveyor and sending them out on the other. Obviously, machine capacity must be so arranged that the entire system is in balance to prevent accumulation of the castings at any point. Between the conveyors, hoists and rails are grouped to facilitate loading and unloading the machines. The layout illustrated is taken from a photostat of the floor plan with templets of all the machine tools arranged in proper order.

Castings are removed from the incoming conveyor for Operation 2. This consists of milling the top and bottom of the blocks, using a drum-type rotary as on the Model A. The block is located from the pads on the banks machined in the first operation and milled on the bottom. Then it is reversed, transferred to the other side of the machine, sup-

Fig. 2—Supported from the bottom, the banks are milled in a large double-sided rotary. The drum carries five blocks on each side



ported from the bottom and milled on the top.

Drag conveyors are located below the floor to carry off the chips from the milling operations. The chips drop through the floor from the machines and are carried to another conveyor which lifts them to the baling machines above the foundry where they are packed in sheet-metal containers for return to the cupola.

All rough milling cuts are made with Stellite tools operating at about 90 feet per minute with a feed of 18 to 20 inches per minute. The finishing cutters are of tungsten-carbide, operating at 140 feet per minute. Roughing tools are ground after six hours continuous work, but finishing tools are good for 100 hours.

Both the Model B four-cylinder block and the V-8 are handled in the same line. For the operation just described the five machines at the left are used on the Model B, and the eight machines on the right on the V-8. Approximately half the machines used on the V-8 block have been revamped from the Model A. Sufficient of the old machines are retained to take care of the Model B blocks which pass through the department. However the entire floor plan has been altered, and the conveyors have been rebuilt to accommodate the wider block. The over-all width of the conveyors is six inches greater than for the old line. The carriages are entirely new.

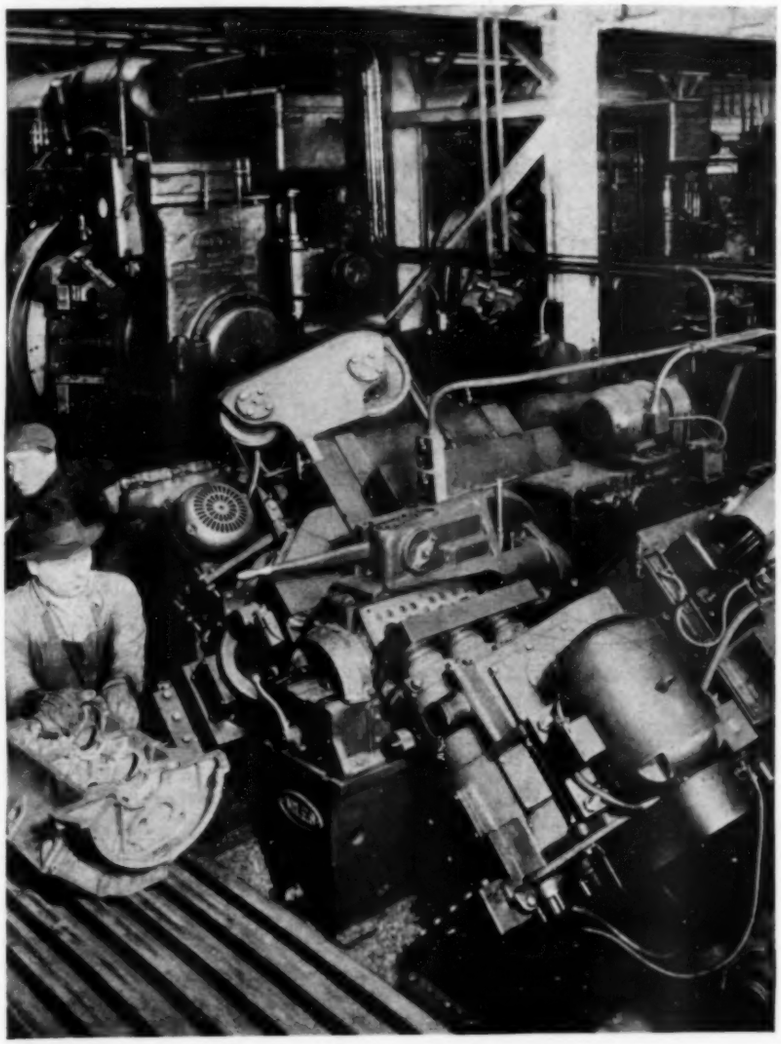
Next the main bearing bolt holes are drilled from the bottom as shown in Fig. 1. The positioning of the block in this machine is highly important because the bearing cap holes serve as locating points for many of the subsequent operations and must therefore be accurate. The problem is to locate the block from the two cylinder banks so as to obtain the most advantageous position for the eight rough bores.

The block is first brought snugly against two guide strips on each side by elevating it until the locating pads on the banks bear against them. Then the inside of the two end bores on each bank is engaged by the fingers of a special equalizing device operated by a floating cam. This arrangement locates the block endwise so the walls of the bores will be as nearly uniform as possible. The block is then clamped from the bottom and drilled. The entire slide is fed downward against the drills by means of a worm mechanism. A hydraulic cylinder provides rapid return after the operation is completed. Drilling is done at 80 to 90 feet per minute using high-speed drills.

One hole at each end of the block is then reamed, location being obtained from the two end holes that are not reamed. The reamed holes serve to locate the casting for most of the subsequent operations where precision is required. While this work is being done from the bottom of the block, the six bearing holes are counterbored from above and two additional holes are drilled.

Operations 5 and 6 which follow are similar to operation 2. Both are done on rotary mills, the first machining the ends and the second the banks. In all these operations, a rough and a finishing cut are taken. Operation 6, illustrated in Fig. 2, is of course new on the V-8 block but uses a familiar type of machine. The casting rests solidly against its bottom face in the fixture, located by two steel pins which fit the main bearing bolt holes in the bottom of the casting. It is held down by two clamps. Two men are used at each machine, one on each side. First one bank is machined and then the other, the locating pads being removed.

Fig. 3—Combining operations has reduced the number of steps required. Here the front camshaft boss is roughed out while the exhaust pads are finished

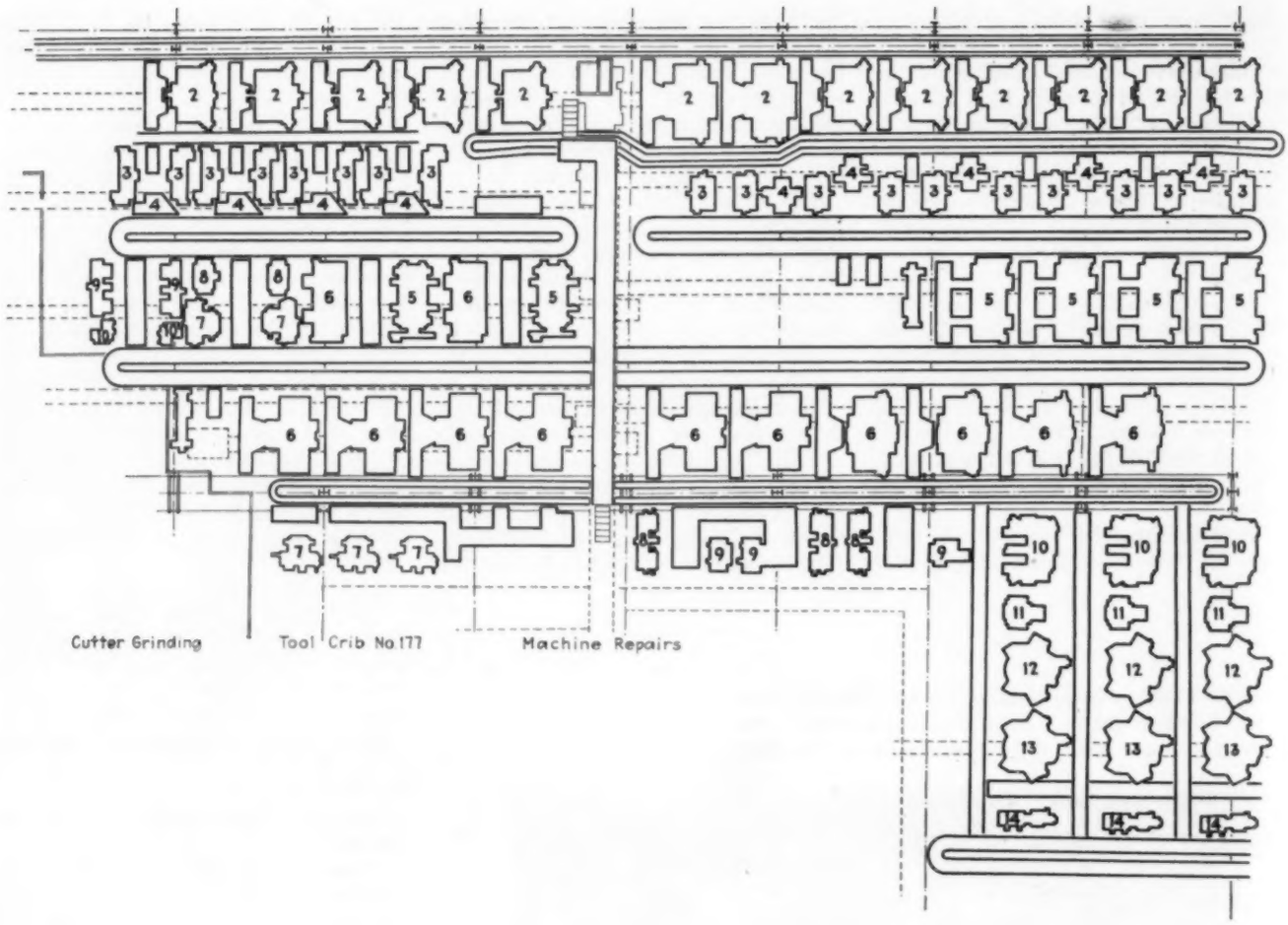


Bank Angles are Checked

Again locating from the main bearing bolt holes by pins, the radius of each bearing is milled in a three-spindle vertical mill using form cutters. The casting is then inspected with four dial indicators on each side to show the angularity of the banks. They must be kept within plus or minus 0.005 inch.

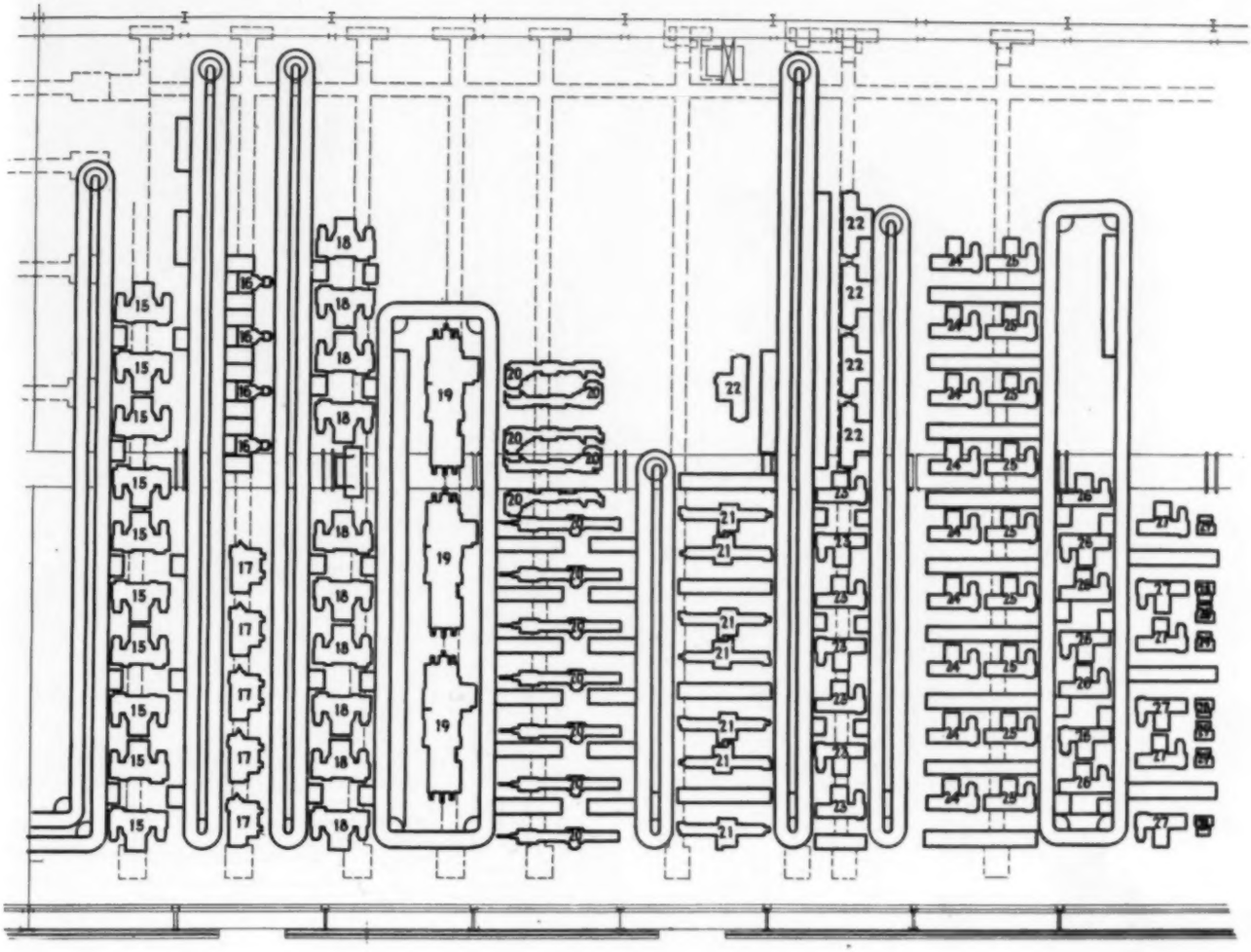
Then a single acting clamp holds the casting top and bottom at both ends while the main bearings are straddle milled using six cutters. Next the bearing grooves are milled, the cutters being fed downward by hand. The table lifts the casting hydraulically to position it in the fixture.

The exhaust pads, three on each side, are then machined in a seven-spindle

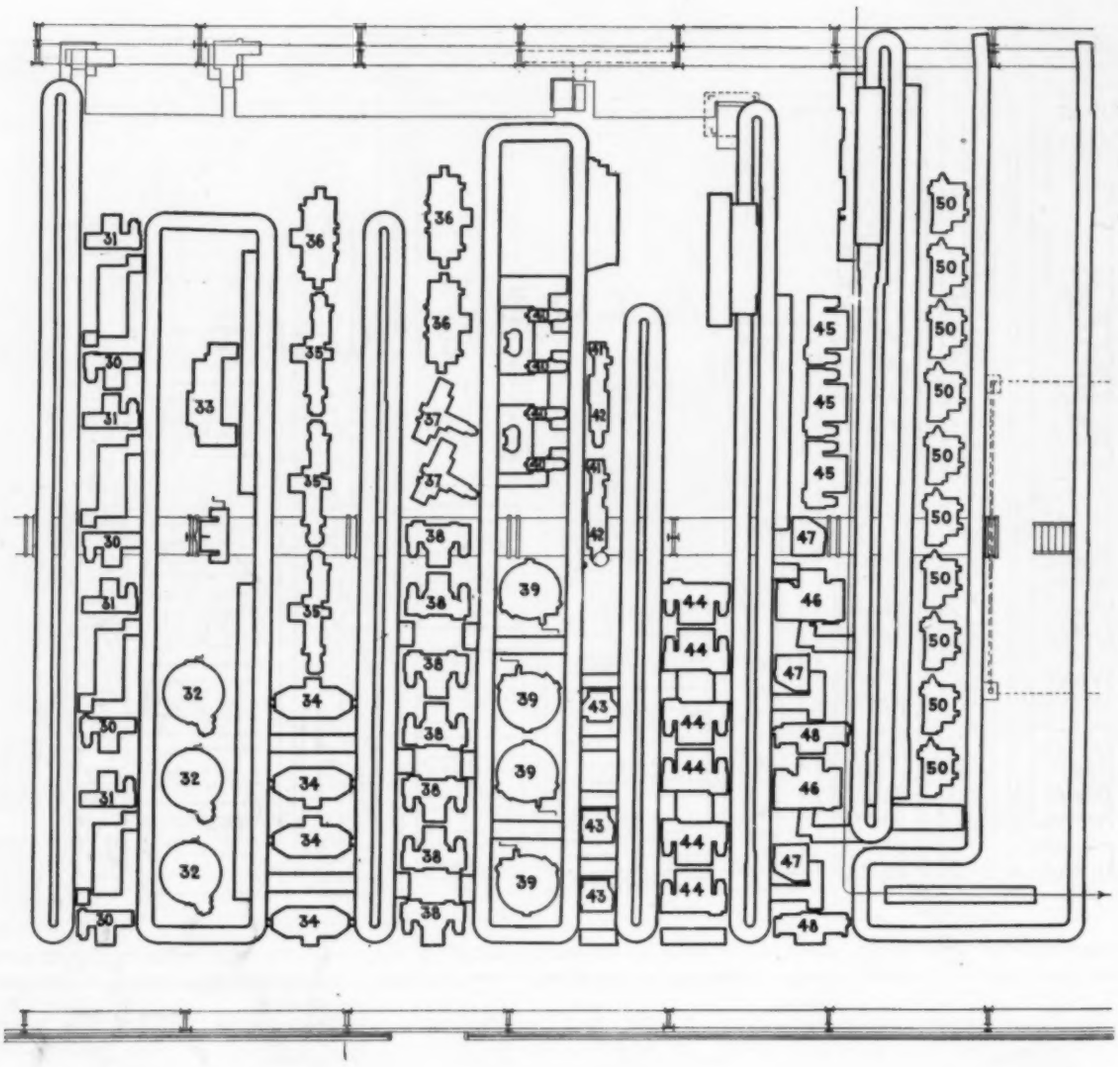


Machining Operations on the V-8 Cylinder Block

OPERATION NUMBER	OPERATION	NUMBER OF MACHINES REQUIRED	PRODUCTION PER HOUR
1	Mill locating pads	3	60
2	Mill top and bottom	10	26
3	Drill main bearing bolt holes and two long oil holes; rough one 1⅜-in. hole	10	22
4	Ream two locating bolt holes; counterbore six bolt holes and drill ⅝-in. hole; also 0.4365 drilled holes and ⅜-in. oil-hole part way	5	44
5	Mill ends	4	70
6	Mill both banks	10	26
7	Mill radius in main bearings	4	70
8	Straddle mill main bearings and fillet	3	80
9	Mill grooves in center of bearings	3	80
10	Mill exhaust pads and rough spot-face front cam bearing	3	70
11	Drill anchor holes	3	60
12	Rough and finish mill pump drive gear pad	3	70
13	Rough and finish mill oil-slinger groove	4	70
14	Line ream main bearings and bore 2.312 — 2.313 rad. and face	3	70
15	Rough bore cylinder	12	20
16	Chamfer bottom of cylinder bore	4	100
17	Rough water test	5	35



OPERATION NUMBER	OPERATION	NUMBER OF MACHINES REQUIRED	PRODUCTION PER HOUR
18	Semi-bore cylinders	11	22
19	Drill camshaft hole	3	70
20	Line ream camshaft hole	12	30
21	Rough and finish machine 7.000–7.002 dia.; finish spotface front camshaft boss; rough and finish idler gear hole; drill and ream 0.312–0.3125 in center; drill oil gage hole and drill hole	7	30
22	Drill two oil-holes from camshaft hole to pipe; drill for ¼ pipe 2 in. deep, ¼ drill from top; drill ⅜ and $\frac{17}{64}$ hole in rear end on 4½ deg. angle and drill one oil-hole in front end; also ⅜-in. hole to depth	5	60
23	Machine valve chamber hole	7	40
24	Drill valve guide holes and push rod holes	9	22
25	Semi-drill valve guide and push rod holes	9	22
26	Flycut valve guide holes	7	30
27	Machine for valve clearance	6	40
28	Spotface and chamfer for bushing-R.H. bank	4	25
29	Spotface and chamfer for bushing-L.H. bank	4	25



OPERATION NUMBER	OPERATION	NUMBER OF MACHINES REQUIRED	PRODUCTION PER HOUR
30	Ream valve guide holes	5	40
31	Flycut valve seat diameter	5	40
32	Drill, re-drill, flycut and ream oil-pump hole	3	35
33	Broach grooves in main bearings	1	..
34	Machine all port holes; spotface 1¼-in. boss for oil-relief valve in front end	4	60
35	Drill all holes in bottom and ends	3	70
36	Drill all holes in top, both banks and both sides, for manifold and port holes; drill ¼-in. hole in front camshaft hole from top	4	70
37	C'sink stud holes in tops of banks	2	80
38	Finish ream and chamfer bore	8	52
39	Rough and finish hollow mill main bearing grooves in 3.625 I.D. and 4.125 O.D	4	60
40	Babbitt bearings	4	60
41	Mill gates	2	80
42	Peen babbitt	4	60
43	Straddle mill main bearings	3	..
44	Hone bores	7	30
45	Burnish bores	3	60
46	Tap top, both sides and ⅛-in. pipe hole	2	90
47	Tap two pipe holes for oil-holes; ream 0.4365–0.4375 gas pump holes; refinish 45 deg. ball seat; ream two dowel holes in top	3	..
48	Tap bottom and ends	2	90
49	Wash in conveyor line, spray soda solution	1	..
50	Finish water test	..	..

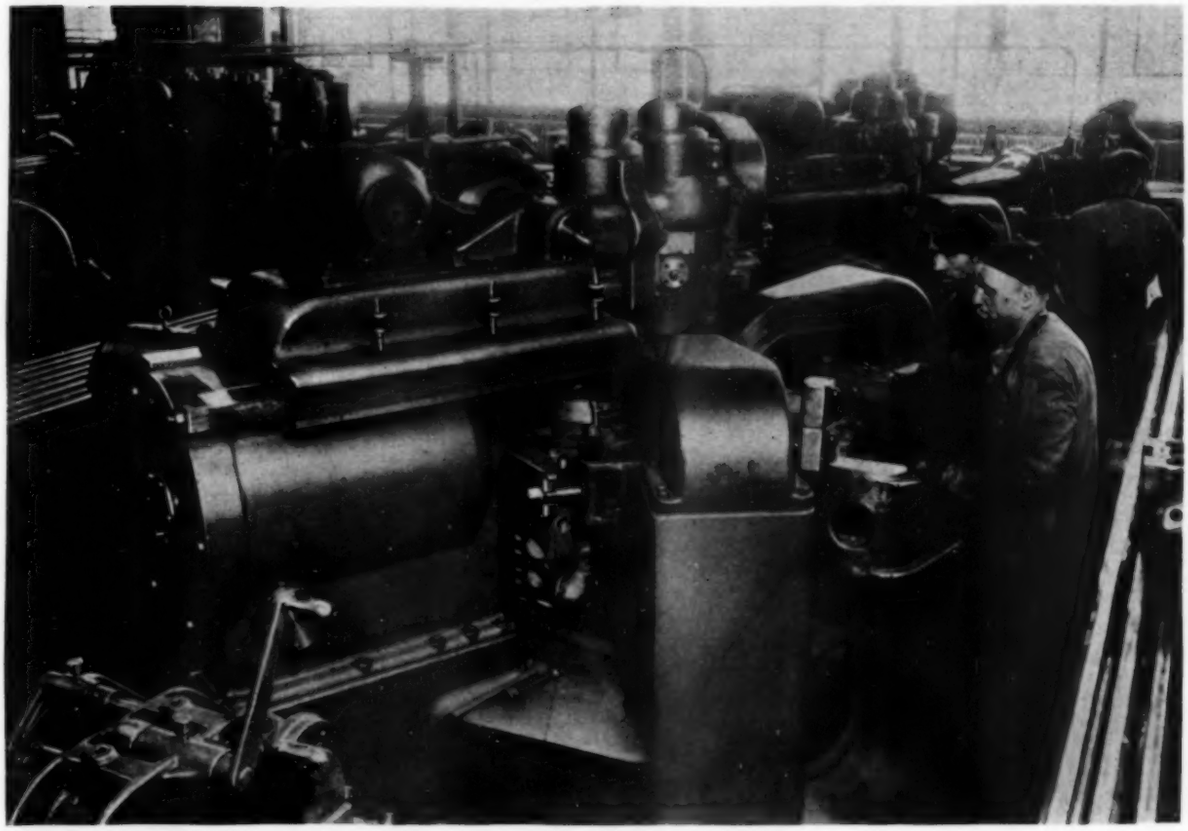


Fig. 4—A three-station rotary mill roughs and finishes the rear face of the block and cuts the oil slinger groove

mill, the block being guided by means of a half-round slide in the main bearings as shown in Fig. 3. The front camshaft boss is given a roughing cut at the same time. The cutters are backed away automatically after each operation. The bearing anchor holes are drilled on a two-way machine of Ford design, six holes being put in each bearing. The drills are fed upward through the locating strip on which the bearings rest.

The casting then goes through two Ford designed three-station mills which are automatically indexed. The first of these rough and finish mills the pump driving gear pad, while the second roughs and finishes the oil slinger groove

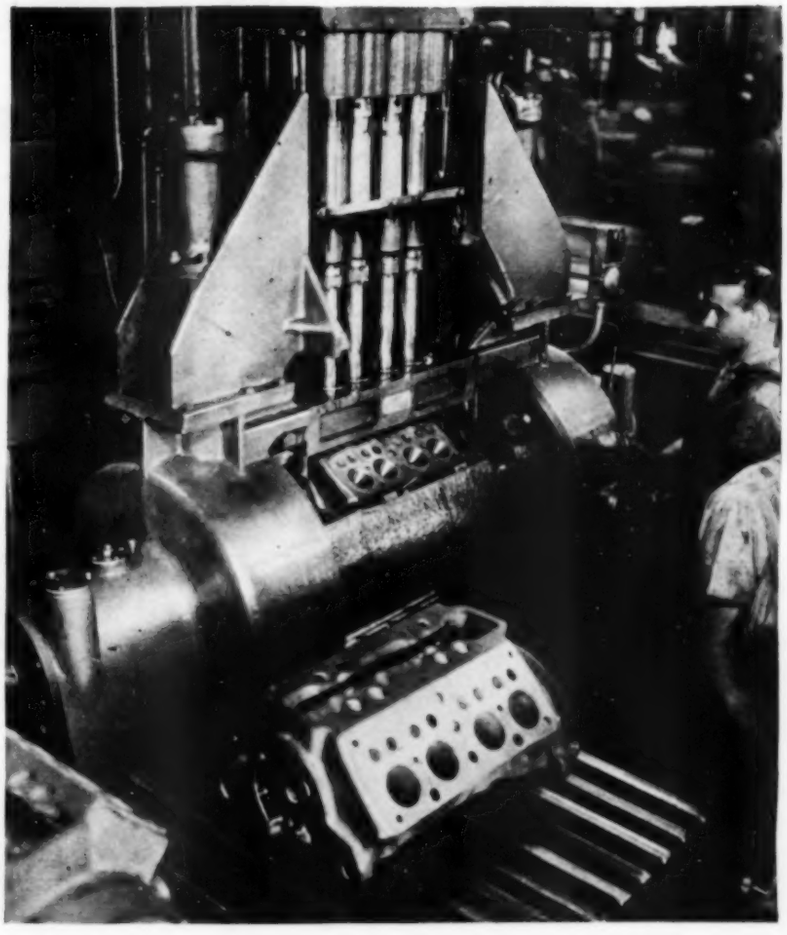


Fig. 5—One bank at a time, the blocks are rough bored. The indexing fixture rotates the blocks 90 degrees and traverses them ⅞ in. lengthwise to provide for the cylinder offset

as shown in Fig. 4. The bearings are then line-reamed in a special fixture using a cutter bar followed by a reamer. The work is fed while the tools remain stationary.

A battery of Ford design, four-splindle vertical drills rough bores the cylinders. This set-up, illustrated in Fig. 5, is of interest because it is the first of a number which use a cradle arrangement for performing the same operation successively on both banks. This is accomplished by a hydraulically operated indexing fixture which rotates the casting 90 degrees and at the same time gives it a lengthwise travel of 7/8 inches. This is to take care of the 7/8-inch offset between the two banks of cylinders to allow for the two opposite connecting rods on each crank. A cam on the

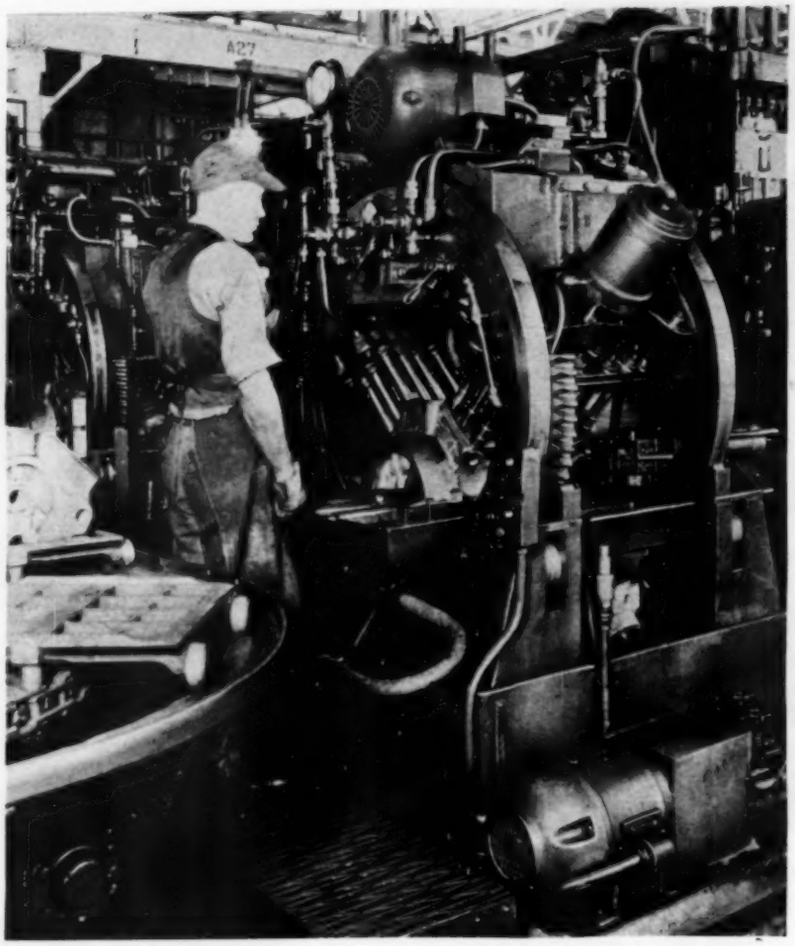
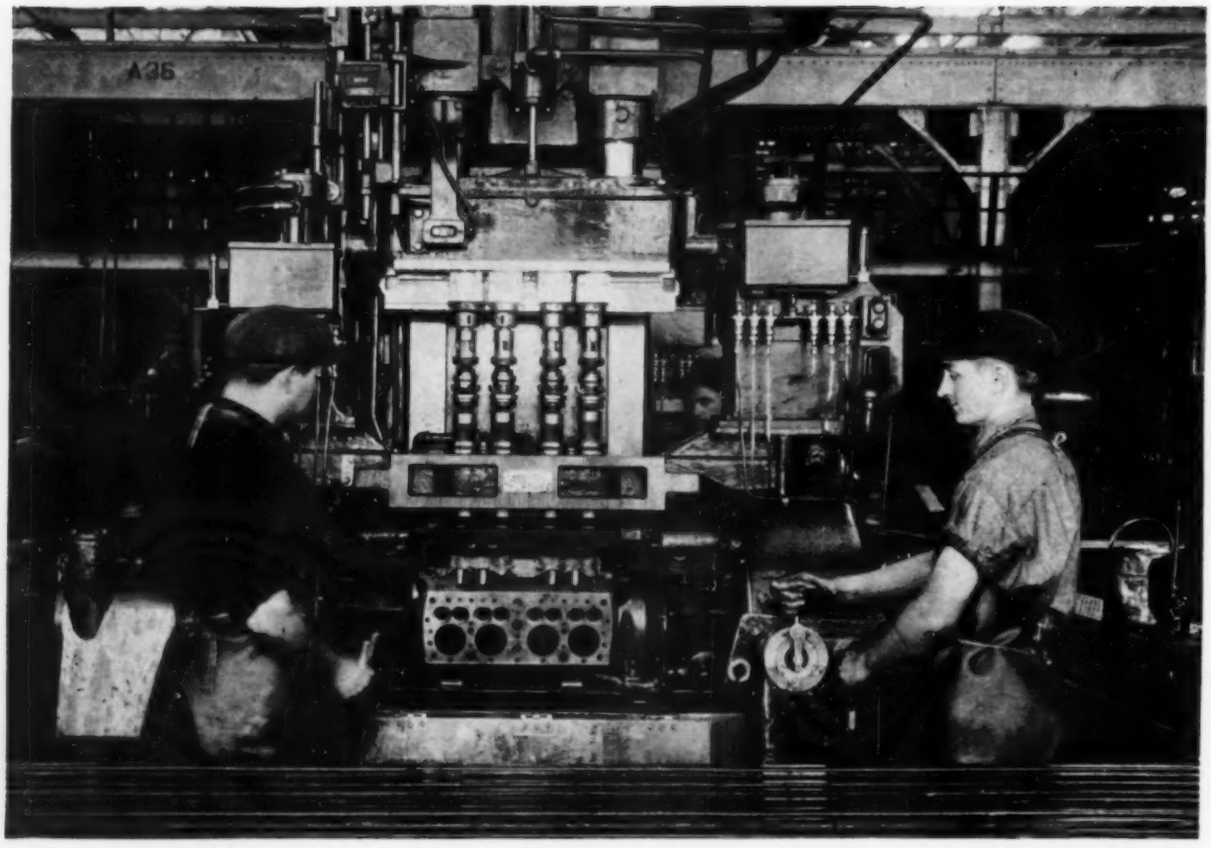


Fig. 6—Each casting is tested hydraulically in a special fixture which is rotated to permit inspection from all sides

Fig. 7—Honing gives a fine finish to the cylinder bores. The automatic indexing fixture is again used on this machine



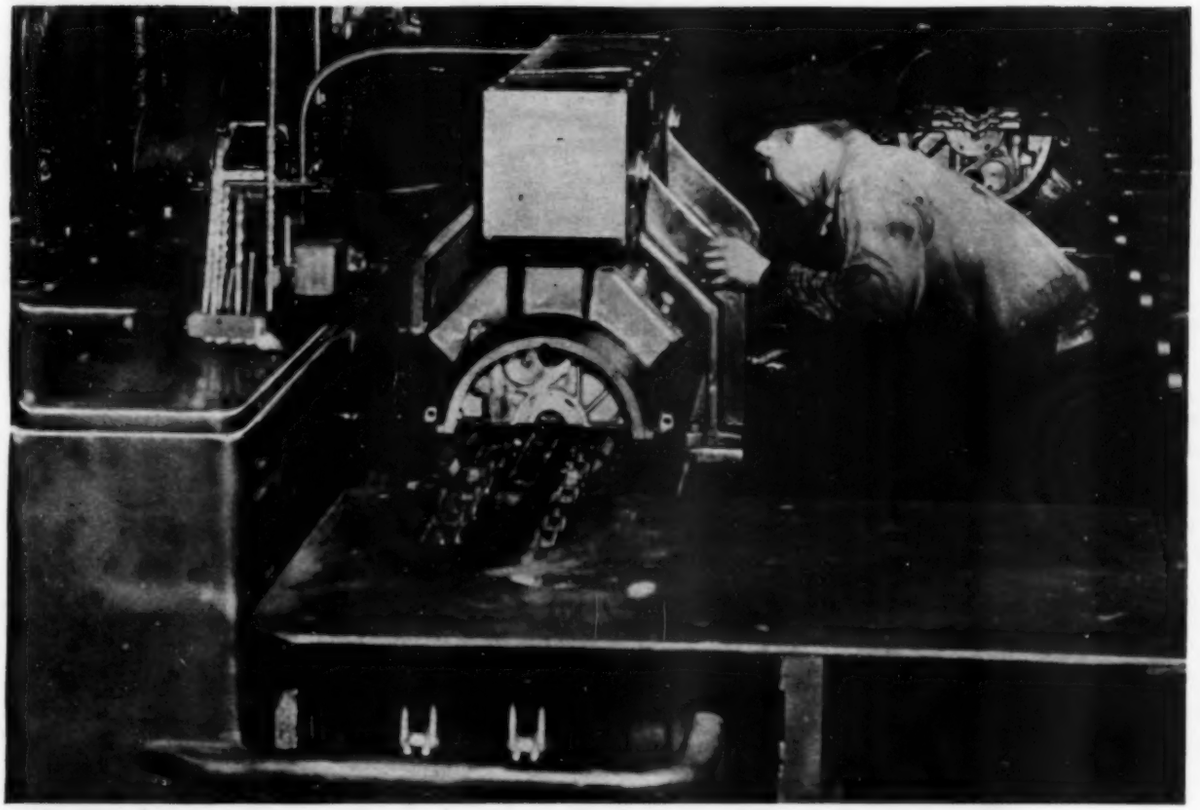


Fig. 8—Longitudinal anchor grooves are cut in the main bearings by a new design chain-driven broaching machine

trunnion of the cradle produces this endwise motion. These particular machines are revamped from use on the old Model A. They are hydraulically fed as are most of the drilling machines in the block line.

The cylinder bore is then chamfered in a two-spindle drill using a hand feed, one operator completing a bank in two set-ups, while the next operator machines the opposite bank. The block then receives the first water test in a new type of fixture, shown in Fig. 6, which permits inspection of the block from all sides. This device aided greatly in the correction of some of the initial difficulties with the V-8 block. A pressure of 50 pounds of water at 180 degrees is applied with all ports covered by means of rubber pads on the ends of hydraulically operated plungers. Any tendency to leak likely to develop in the walls of the block will show up at this pressure. As will be noted from the illustration, the entire fixture is oscillated so that all parts of the casting may be observed for pin holes.

Five separate steps are required to finish the cylinder bores. The rough boring operation has already been described. The second follows the water test and consists in semi-boring with

Fig. 9—A five-station rotary machine drills, bores and reams the camshaft hole

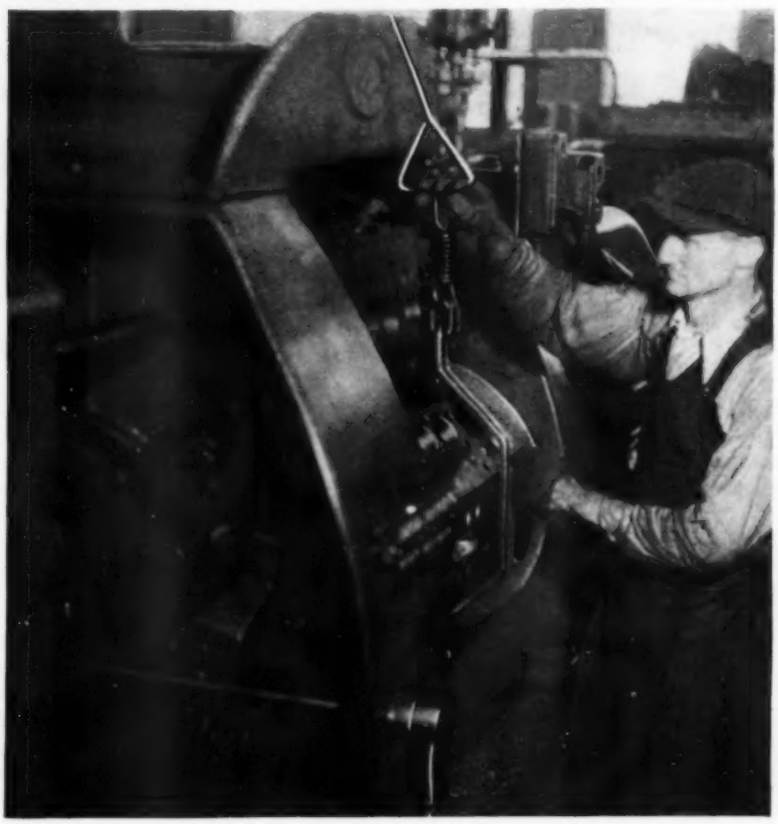


Fig. 10—In this setup, 83 holes are drilled in five directions. This is typical of the extent to which operations have been confined

the removal of 0.020 inches of metal. The cradle type fixture already described is again used. Finish reaming removes another 0.010 inches of metal. Honing, the fourth step, shown in Fig. 7, takes out another 0.005 inches. A final burnishing operation completes the bores and gives them a smooth close-grained finish.

Tool Adjustments

Both honing and burnishing are done four cylinders at a time, using hydraulically operated indexing fixtures. In each head, micrometer adjustments are provided, and the operator inspects the bores for size with an indicating gage while the block is still in the fixture. The honing tools are flooded with kerosene while cutting.

After semi-boring, the camshaft holes are drilled and reamed in special rotary Four-station machines as shown in Fig. 8. Three cutter bars are used. The same holes are then line-reamed with the blocks located by pins from the main bearing bolt holes. The next operation consists in roughing and finishing the flywheel and timing gear housings and drilling a number of holes at the same time. Special Ford designed machines are employed with the castings guided by half-round bars in contact with the main bearings.

Valve Holes Operations

A five-way machine next drills a variety of oil holes. The valve chamber holes are then put in both banks, the cradle-type indexing fixture again being employed. This is followed by the drilling and semi-boring, the valve guide and push rod holes. Then the valve guide holes are fly cut in a separate operation. Eight-spindle machines, all of the same general type, are used for these opera-

tions, and are provided with indexing fixtures to rotate the casting for each bank. The next operation, that of machining for valve clearance, is similar.

Right- and left-hand banks are then spotfaced and chamfered for the bushings in two operations on special machines. The valve guide holes are reamed on each bank, using an eight-spindle machine with indexing fixture, following which the valve seat is fly cut.

Anchor Grooves are Broached

The castings are then put into a box fixture with rollers to facilitate handling the work. A five-station machine drills, redrills, fly cuts and reams the oil pump hole. The longitudinal anchor grooves in the main bearings are then broached as illustrated in Fig. 9. The broach is stationary and the casting is carried over it by chains while being held down by a traveling belt at the top of the fixture. A center guiding strip fits the bearings and supports the broach. This is another new Ford design.

A five-way drill then machines all port holes, again locating from the main bearing. A three-way drill puts the holes in the bottom and both ends. Another five-way machine puts all holes in the top, both banks, and both sides, 83 holes in all as shown in Fig. 10. The next operation is to countersink the stud holes in the end and banks, using a three-way machine.

The circular grooves, mentioned for locating the main bearing caps, are machined in the next operation. This is done by hollow milling in a three-station machine. One station is used for loading, the second for roughing, and the third for finishing. Each station has three spindles, one for each bearing. The outside diameter of the cutters is 4.125 inches. Because of the sweep of the cutters, the two reamed main bearing bolt holes, usually used for location cannot be employed. So for this operation, the block is located from the two end camshaft bearings and positioned endwise from the oil pump hole.

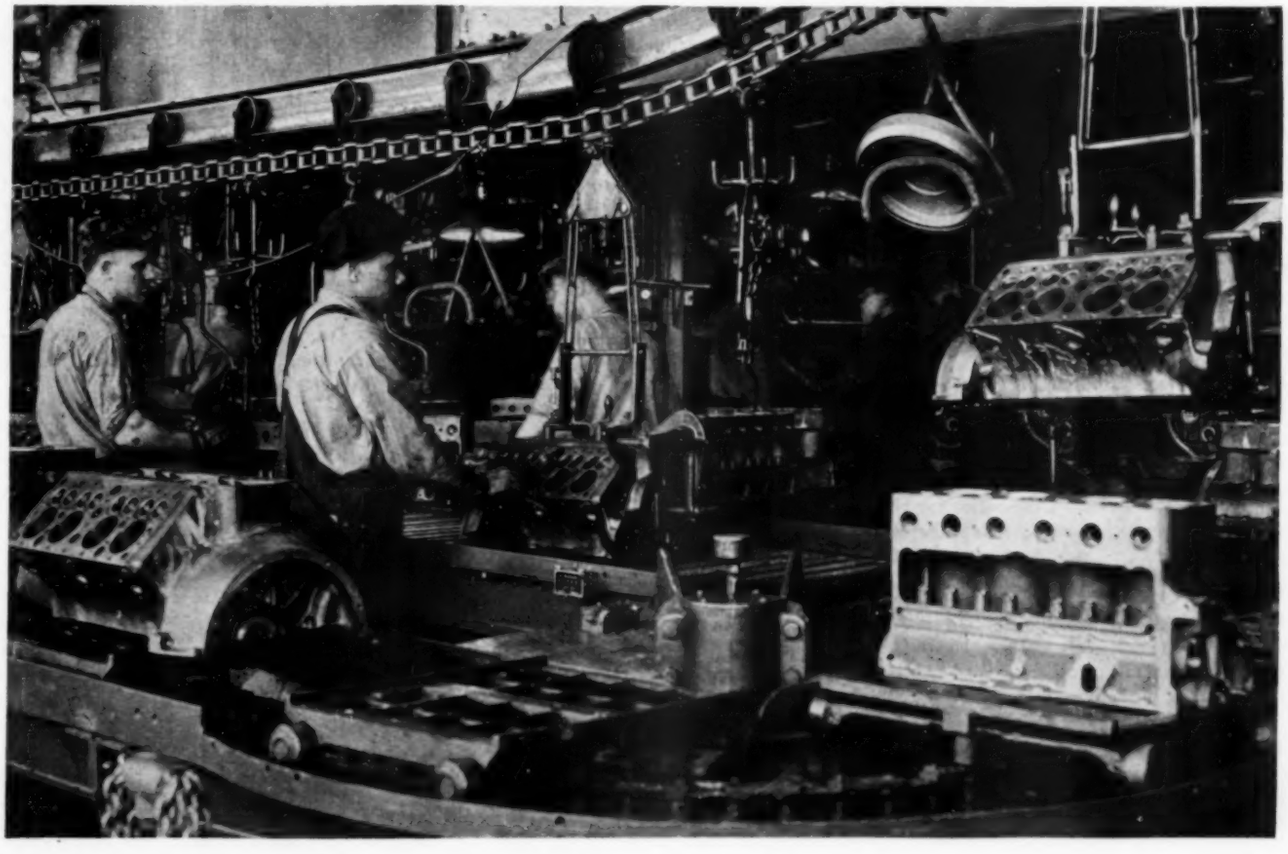
The bearings are then babbitted, using the same means of location, the gates milled off, and the babbitt peened in three separate operations. The peening is performed with pneumatic hammers supported vertically in a special fixture and having special half-ground ends. Then the main bearings are straddle-milled. In addition to the honing and burnishing already described, the remaining operations consist of drilling and tapping miscellaneous holes. The blocks are then washed with a soda solution and given a final water test. The fixtures employed are the same as those used for the first test. The blocks are then hooked to an overhead conveyor, shown in Fig. 11, which carries them to the assembly department through a covered runway. The blocks are painted by spraying while passing through this runway.

Hydraulic Valve Grinding

In the motor assembly department, the main bearings are run in on a special machine alongside the conveyor line. After assembly of the valves and valve springs, the valves are ground on a special machine which is hydraulically operated. Oscillation of the spindles grinds in the eight valves on one bank, and the fixture is then rotated to position for the other eight.

Thus goes the endless stream of V-8 blocks to be transformed into complete motors. Some are then carried to the main assembly line at River Rouge soon to come forth under the hoods of shiny new Fords. Others are shipped to the many Ford assembly plants located in all parts of the world.

Fig. 11—Leaving the machine line, the block travels overhead to the assembly floor



When a Pieceworker Runs Several Machines

A fair rate must be based on probable idle machine time. To determine the most economical number of units for one operator, machine efficiency should be weighed against man efficiency

D. W. PINKERTON

FREQUENTLY the piecerate department is confronted with the necessity of setting rates where two or more machines are being operated by one man. If the machines are loaded with long-run orders, a simple timestudy under actual operating conditions will usually suffice as a basis for rate setting; however, long-run orders are the exception in these times of depression, so that numerous small orders mixed in with a few large ones may be expected.

Stated briefly, the problem confronting the piecerate department is economically to establish fair rates for the operator, regardless of the kind or number of machines he is given to operate, the size of the orders, or the type of work. Before it is possible to proceed with the solution of the problem, certain assumptions regarding operating conditions must be made. They are:

1. That the operator, while tending one machine, can give this machine his undivided attention; in other words, that all machines are either equipped with stops or are fully automatic.

2. That the machining time may be predetermined with a fair degree of accuracy.

3. That a capable production checker is constantly available to make rate computations and to record and allow for abnormal conditions such as breakdowns.

Proceeding to the solution of the problem:

Let H_1 = the normal time required for the operator to load, unload, inspect, start and stop the machine, and any other necessary piece or machine handling elements on the first machine, and to walk the mean distance from the first machine to another machine that is ready to unload and to commence work, all on a per-piece basis.

Let H_2, H_3, H_4, etc. = the same items for the second, third, fourth, etc., machines, respectively.

Let M_1 = the balance of the machining time on the first machine (consisting of the total machining time minus the walking time) also on a per-piece basis.

Let M_2, M_3, M_4, etc. = the same for the second, third, fourth, etc., machines, respectively.

Then $H_1 + M_1$ = the cycle time per piece on the first machine, and $H_2 + M_2$, $H_3 + M_3$, $H_4 + M_4$, etc. = the cycle times per piece on the second, third, fourth, etc., machines, respectively.

Let $m_1 = \dfrac{M_1}{H_1 + M_1}$ = that part of the cycle of the first machine during which it could be machining without the operator being present (disregarding the fact that walking would not be necessary for single machine operation) and which, therefore, represents the idle fraction of the operator's time when operating the first machine alone.

Let m_2, m_3, m_4, etc. = the same for the second, third, fourth, etc., machines, respectively.

It is obvious that if the operator is operating the first machine alone, the probability that he will be idle at any given instant is represented by the fraction m_1; in a like manner, the fractions m_2, m_3, m_4 represent the probabilities that he will be idle at any given instant when operating the second, third, fourth machines, respectively, alone. If he be given the first and second machines to operate, the probability that he is idle at any given instant becomes (according to the laws of chance) the product of the individual probabilities, or m_1m_2. Similarly, the probability that he is idle at any given instant when operating n machines is $m_1m_2m_3m_4 \ldots m_n$. For the sake of brevity, this term will be called P. Since the fraction P represents the probability that the operator will be idle at any given instant when operating n machines, the operator will, on the average, be idle P of the time.

If the operator is idle P of the time, he will be working $1 - P$ of the time. Since the working time is to be the basis for compensating the operator, the cost or value of the idle time must be spread over the working time.

It is common practice to use a different factor of relaxation (and incentive) for idle time than for pure working time. Therefore:

Let R = relaxation factor for pure work time.

Let S = relaxation factor for idle time. Then $R(1 - P)$ = relaxed working fraction

SP = relaxed idle fraction

$R(1 - P) + SP$ = relaxed aggregate or whole.

Assume for the moment that time or money piecerates, based on relaxed working time only, have been established for each machine. These rates would compensate the operator for actual work done but would not pay him for his idle time; completely to compensate him, it will be necessary to multiply each piecerate by a factor which is the ratio of the relaxed aggregate to the relaxed working fraction. Calling this factor F, then:

$$F = \frac{R(1 - P) + SP}{R(1 - P)}$$

$$F = 1 + \frac{SP}{R(1 - P)}$$

This formula may be solved readily by the use of Table I. For the purpose of simplification, S/R was assumed to be equal to 0.933; it was further assumed that the piecerate department would establish in advance the machining fraction (m) on each job along with the piecerate based on relaxed working time only.

The table consists of three columns labeled *No.*, m or P, and F; in the second column, find the m nearest to the

m for the job on the first machine. Opposite this m, in the first column is a number; this number is to be added to the numbers obtained in a like manner for the second, third, fourth and subsequent machines, respectively. Find the sum (or number nearest it) in the first column and opposite it in the second column will be the value of P, and in the third column F for this combination of jobs. This F is then used to multiply each time or money rate for the particular operator.

An example will best illustrate the use of Table I in multiple machine operation. Accordingly, assume that an operator whose rate is 50 cents per hour ($0.00833 per minute) is given five machines to operate, the jobs having the characteristics shown in Table II. Determine his earnings for the day (8 hours), with R equal to 1.25.

It will be noted that a different P, and therefore a different F, will result whenever the number of machines changes, or one job runs out and another is substituted for it. As it is obviously unprofitable to calculate F, tabulate production, and make the necessary extensions a number of times daily, some quicker method must be resorted to where small-run orders are the rule.

In such cases, it will probably be advisable to compute an average F for the pay period, to be used on all jobs run during this period. If the number of machines operated at one time is large and the stream of orders fairly constant, an average F obtained from an average m and an average n should suffice. On the other hand, if the class of work and the number of machines operated varies widely, it will probably be necessary to split up the pay period into a number of sub-periods and to obtain a weighted average F from these sub-periods at a somewhat greater effort. Consequently, the exact method to be used to obtain an average F, which will be inexpensive and still give a reasonable degree of accuracy, will depend largely on local conditions.

Table I

No.	m or P	F	No.	m or P	F	No.	m or P	F
1	0.977	41.0	51	0.309	1.417	105	0.0891	1.0913
2	0.955	20.8	52	0.302	1.404	110	0.0794	1.0805
3	0.933	14.1	53	0.295	1.391	115	0.0708	1.0711
4	0.912	10.7	54	0.288	1.378	120	0.0631	1.0628
5	0.891	8.64	55	0.282	1.366	125	0.0562	1.0556
6	0.871	7.30	56	0.275	1.355	130	0.0501	1.0493
7	0.851	6.34	57	0.269	1.344	135	0.0447	1.0436
8	0.832	5.62	58	0.263	1.333	140	0.0398	1.0387
9	0.813	5.05	59	0.257	1.323	145	0.0355	1.0343
10	0.794	4.60	60	0.251	1.313	150	0.0316	1.0305
11	0.776	4.23	61	0.245	1.303	160	0.0251	1.0240
12	0.759	3.87	62	0.240	1.295	170	0.0200	1.0190
13	0.741	3.67	63	0.234	1.286	180	0.0158	1.0150
14	0.724	3.45	64	0.229	1.277	190	0.0126	1.0119
15	0.708	3.26	65	0.224	1.269	200	0.0100	1.0094
16	0.692	3.10	66	0.219	1.261	250	0.00316	1.0030
17	0.676	2.95	67	0.214	1.254	300	0.00100	1.0009
18	0.661	2.82	68	0.209	1.247	400	0.00010	1.0003
19	0.646	2.70	69	0.204	1.239	500	0.00001	1.0001
20	0.631	2.60	70	0.200	1.233			
21	0.617	2.50	71	0.195	1.227			
22	0.603	2.42	72	0.191	1.220			
23	0.589	2.34	73	0.186	1.214			
24	0.575	2.26	74	0.182	1.208			
25	0.562	2.20	75	0.178	1.202			
26	0.550	2.14	76	0.174	1.196			
27	0.537	2.08	77	0.170	1.191			
28	0.525	2.03	78	0.166	1.186			
29	0.513	1.983	79	0.162	1.181			
30	0.501	1.937	80	0.158	1.176			
31	0.490	1.896	81	0.155	1.171			
32	0.479	1.857	82	0.151	1.166			
33	0.468	1.821	83	0.148	1.162			
34	0.457	1.786	84	0.145	1.158			
35	0.447	1.754	85	0.141	1.153			
36	0.437	1.724	86	0.138	1.149			
37	0.427	1.695	87	0.135	1.145			
38	0.417	1.667	88	0.132	1.142			
39	0.407	1.641	89	0.129	1.138			
40	0.398	1.617	90	0.126	1.134			
41	0.389	1.594	91	0.123	1.131			
42	0.380	1.572	92	0.120	1.128			
43	0.372	1.552	93	0.117	1.124			
44	0.363	1.532	94	0.115	1.121			
45	0.355	1.513	95	0.112	1.118			
46	0.347	1.496	96	0.110	1.115			
47	0.339	1.478	97	0.107	1.112			
48	0.331	1.462	98	0.105	1.109			
49	0.324	1.447	99	0.102	1.106			
50	0.316	1.431	100	0.100	1.104			

Table II

Mach. No.	H	M	$H+M$	*	m	No.	P	F	Pieces in 8 hr.	†	Earnings
1	2.43	4.72	7.15	0.0253	0.661	18	0.324	1.447	48	0.0366	$1.76
2	1.94	9.27	11.21	0.0201	0.827	8	0.324	1.447	31	0.0292	0.91
3	1.15	16.11	17.26	0.0120	0.933	3	0.324	1.447	20	0.0173	0.35
4	1.52	38.52	40.04	0.0158	0.965	2	0.324	1.447	9	0.0229	0.21
5	1.13	2.19	3.32	0.0118	0.660	18	0.324	1.447	105	0.0170	1.79
Total						49					$5.02

*This is the predetermined piecerate for pure work only, consisting of 0.00833 HR.
†This is the piecerate paid the operator for this combination of machines only, consisting of 0.00833 HRF.

Modifications Occasionally Needed

Sometimes it may be necessary to alter slightly the method of handling orders, or to make minor changes in equipment and routine so as to modify the extreme values of P. Indeed, with the cooperation of the shop, it should even be possible to establish a fixed P (and F) which the shop supervision and the planning department will endeavor to maintain by lengthening or shortening the hours of work. This latter would be ideal, not only for the piecerate department, but for the estimating and standard-cost departments as well.

It should be born in mind at all times that the above formula presupposes random conditions as regards the characteristics of the work on the various machines as well as random operation; actually, random conditions seldom exist, and the operator can, to a certain extent, control the operation. The net effect of this non-conformity is to make the values of F a trifle loose; in other words, the operator will be overpaid slightly. For this reason also, the formula should never be used when an operator is operating a number of machines which are loaded with jobs having identical characteristics.

The question of reduced machine output with multiple machine operation will probably arise. It is true that as the

Table III

	n = Number of Machines Operated										
m	1	2	3	4	5	6	8	10	12	15	20
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
0.99	1.00	0.99	0.99	0.98	0.98	0.97	0.97	0.96	0.95	0.93	0.91
0.98	1.00	0.99	0.98	0.97	0.96	0.95	0.93	0.91	0.90	0.87	0.83
0.97	1.00	0.98	0.97	0.96	0.94	0.93	0.90	0.87	0.85	0.81	0.76
0.96	1.00	0.98	0.96	0.94	0.92	0.90	0.87	0.84	0.80	0.76	0.70
0.95	1.00	0.97	0.95	0.93	0.91	0.88	0.84	0.80	0.76	0.72	0.64
0.94	1.00	0.97	0.94	0.91	0.98	0.86	0.81	0.77	0.73	0.67	0.59
0.93	1.00	0.96	0.93	0.90	0.87	0.84	0.79	0.74	0.69	0.63	0.55
0.92	1.00	0.96	0.92	0.89	0.85	0.82	0.76	0.71	0.66	0.59	0.51
0.91	1.00	0.95	0.91	0.87	0.84	0.80	0.74	0.68	0.63	0.56	0.47
0.90	1.00	0.95	0.90	0.86	0.82	0.78	0.71	0.65	0.60	0.53	0.43
0.88	1.00	0.94	0.88	0.83	0.79	0.74	0.67	0.60	0.55	0.47	0.38
0.86	1.00	0.93	0.87	0.81	0.76	0.71	0.63	0.56	0.50	0.42	0.34
0.84	1.00	0.92	0.85	0.79	0.73	0.67	0.59	0.51	0.46	0.38	0.30
0.82	1.00	0.91	0.83	0.76	0.70	0.64	0.55	0.48	0.42	0.35	0.27
0.80	1.00	0.90	0.81	0.74	0.67	0.61	0.52	0.45	0.39	0.32	0.25
0.78	1.00	0.89	0.80	0.72	0.65	0.59	0.49	0.42	0.36	0.30	
0.76	1.00	0.88	0.78	0.70	0.62	0.56	0.46	0.39	0.33		
0.74	1.00	0.87	0.76	0.67	0.60	0.53	0.44	0.37	0.31		
0.72	1.00	0.86	0.75	0.65	0.58	0.51	0.41	0.34			
0.70	1.00	0.85	0.73	0.63	0.55	0.49	0.39	0.32			
0.65	1.00	0.82	0.69	0.59	0.50	0.44	0.34	0.28			
0.60	1.00	0.80	0.65	0.54	0.46	0.40	0.31				
0.55	1.00	0.77	0.62	0.50	0.42	0.36	0.28				
0.50	1.00	0.75	0.58	0.47	0.39	0.33					
0.45	1.00	0.72	0.55	0.44	0.36	0.30					
0.40	1.00	0.70	0.52	0.41	0.33	0.28					
0.35	1.00	0.67	0.49	0.38	0.31						
0.30	1.00	0.65	0.46	0.35	0.28						
0.25	1.00	0.62	0.44	0.33							
0.20	1.00	0.60	0.41	0.31							
0.15	1.00	0.57	0.39	0.29							
0.10	1.00	0.55	0.37	0.28							
0.05	1.00	0.52	0.35	0.26							
0.00	1.00	0.50	0.33	0.25							

number of machines that an operator operates increases, the man efficiency increases, but it is also true that the machine efficiency decreases correspondingly. For the purposes of discussion here, machine efficiency will be defined as the ratio of the output of a given machine operating under multiple machine operation to its output when operated singly, assuming normal operator speed in both cases. Calling this machine efficiency E, it can be shown that:

$$E = \frac{1 - P}{n - S}$$

where n = number of machines operated by one operator,

$S = m_1 + m_2 + m_3 + m_4 + \ldots\ldots + m_n$.

For purposes of theoretical consideration, it is best to compare multiple machine operation of a number of machines working on the identical job with single operation on the same job, in which case:

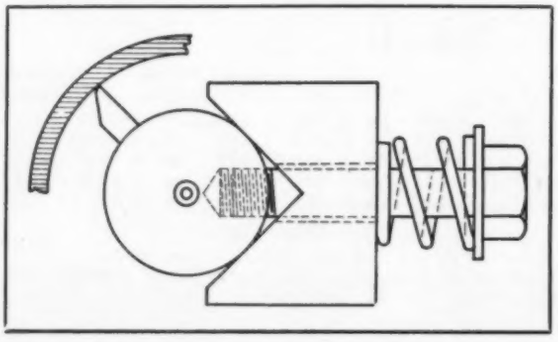
$$m_1 = m_2 = m_3 = m_4, \text{ etc.}$$

$$\text{and } E = \frac{1 - m^n}{n(1 - m)}$$

Table III gives the values of E (above 0.25) for various values of m and n for this latter formula.

In times of depression, when ample machine equipment is available and every direct labor dollar saved means a dollar more in the bank, it will be profitable to operate with a low E and a low F (low machine efficiency and high man efficiency); in boom times, the reverse will probably be true. Accordingly, the correct balance between machine efficiency and man efficiency depends to a large degree on production and the equipment available.

Several books could be written on the subject of multiple machine operation without covering the field completely. The foregoing presents only the broader aspects of that part of the subject which seems to be a stumbling block in most piecerate organizations.



Behavior of Pipe in Threading

WILLIAM ANDERSON

The selection of pipe for a given service seldom takes into account its threading characteristics, and with threading equipment in reasonably good condition, the crux of the problem of poor thread lies in the material. Tests should be made on all pipe received. A simple test can be made with nitric acid after filing and cleaning a bright spot on the pipe. Nitric acid will leave a dark spot on steel pipe. The darker the spot the harder will be the steel and the more difficult to thread. The bright spot on wrought-iron pipe will remain bright after being touched with nitric acid. When threads are persistently leaky and it is difficult to find the source of the trouble, the acid test will clear it up in most cases.

Experience with Vibration
Discussion

F. F. ANDERSON

Most of my troubles with vibration have been chatter on lathe work. Therefore, the oil remedy suggested by Mr. Shaw (*AM*—Vol. 75, page 693) would not be applicable. I have bored a large number of thin-walled cast aluminum measuring utensils, where the depth was greater than the diameter, in a lathe that was not really heavy enough for the job. The sides of the measure would vibrate and give forth a bell-like note that no change of feed would stop. An extremely slow cutting speed would help.

I used two methods to overcome the trouble. First I cut a piece of chain having a weight about the same as the side walls and less length than the outside diameter. By placing the chain around the measure near the open end and holding the ends together with a stiff tension spring, I overcame the vibration in the work.

When the tool hit a rough or porous spot the bar would vibrate for several revolutions. I overcame this by a V block with spring tension. The block was held against the bar so that any shock to the bar would be deadened by the V block. The sketch will show the mounting of the block. A sudden shock would tend to force the bar down and away from the work, but the spring would allow the V block to follow slowly. When the bar started back it was met by the block and its force expended before it could dig into the soft metal.

Methods of Bending Aluminum Tubing

Devices employed must suit the properties of the metal or alloy and the kind of bend required

F. V. HARTMAN
Research Laboratories, Aluminum Company of America

MOST important of the factors, on which the bending of aluminum and aluminum alloy tubing depends, are the mechanical properties of the tubing itself. The size, shape, and ratio of wall thickness to diameter must also be taken into consideration while the method of bending and the equipment used have a definite bearing on the sharpness and accuracy of the bend.

When a tube is bent, the material on the outside of the bend is stretched and that on the inside is compressed. This may be compared to the bending of plate or flat bar, and the material must be ductile enough to permit the stretching and compressing to take place; otherwise, fracture will occur. It is, therefore, quite apparent that ductility is an important property of the material that is to be bent. When sharp tubing bends are desired, this property may be the basis for the selection of a specific alloy or temper. When the selection of the material is governed by other factors, such as chemical properties or mechanical strength, the sharpness of the bends that can be expected will, of course, depend upon the ductility of the material selected and the method of bending that will be employed.

Elongation alone is not a satisfactory criterion of ductility; it is only a partial index. The ratio of yield strength to tensile strength must also be taken into account. However, a combination of high elongation and low ratio of yield strength to tensile strength is possibly the most satisfactory index of ductility.

In addition to the ductility of the material, the size and shape of the tubing are factors that govern the bending of a tube. The sharpness of a bend depends not only upon the diameter of the tubing but upon the ratio of wall thickness to diameter. The problem is, therefore, more complex than that of bending solid materials, such as sheet or bar.

A tube with an extremely heavy wall will have properties somewhat comparable to those of wire or round rod, which in turn will have bending properties quite similar to plate or rectangular bar with rounded edges. Such a tube, however, will have more of a tendency to rupture on the outside of the bend than a rod and, therefore, will require a larger bending radius, when the outside diameters are the same. A tube may also tend to flatten or distort so as to reduce the size of the opening at the bend.

It is quite apparent that the thinner the wall the more tendency there is for rupture on the outside of the bend because the stretching on the outside of the bend thins out the wall to a point where it may fail more easily. In the case of extremely thin-wall tubing, there is also a tendency for failure to occur by buckling on the inside of the bend. This may be likened somewhat to the behavior of a column in that the material has insufficient stiffness when under compression and, therefore, buckles.

The method of bending exerts an influence upon the sharpness of the bend and the degree to which the tube can be bent. Special methods must be employed where severe bends are desired. Small tubing can be bent by hand satisfactorily for some kinds of work. For bending pipe and conduit, a "hickey" is often used. This consists merely of a piece of pipe about 3 ft. long and one or two sizes larger than the pipe to be bent with a tee at one end. The pipe to be bent is supported in a vise with the end projecting; the "hickey" tee is slipped over the end of the pipe and used as a lever or tool for bending. Though crude, this method is often satisfactory. Bending jigs or tools, however, will produce bends less distorted and may be necessary for difficult bends or for large quantity work.

A number of bending methods are illustrated in Figs. 1 to 4. Fig. 1, *A* and *B*, illustrates a simple method that may be satisfactory for some classes of work if the bend is not severe. It consists merely of two pegs on a bench or surface plate between which the tubing is inserted and bent by applying pressure by hand in the direction indicated by the short arrow. The accuracy of the shape of the bend, however, will depend largely upon the skill of the operator. The bend is made a little at a time and the tube is moved farther into the pegs as the bend progresses. In making such a bend, it is quite essential that the tube be moved into the pegs, in the direction indicated by the long arrow, so that the strain from the bending force is not taken by the portion of the tube already bent. If the reverse is attempted, the tubing is more likely to buckle.

Use of a Form

Fig. 2 illustrates another method of bending that is sometimes employed. The tube is placed across two pegs or grooved rollers; a bending form is then brought into play, as indicated by the arrow, in such a manner that the tubing is forced around the form by the pegs. This method is not as well suited for difficult bends because the pegs tend to retard the flow of the metal on the outside of the bend, making the tube likely to fail.

Fig. 3 illustrates a modification of the bending method indicated in Fig. 1. One of the pegs of Fig. 1 has been replaced by a bending form around which the tubing is wrapped. The other peg may be provided with a shoe or bearing block to distribute the load. This method is considerably better than that of Fig. 1 in that it provides a bending form to which the tubing can be bent accurately, and with the full-size bending form, there is less likelihood of the tube collapsing on the inside of the bend. It is also an improvement over that shown in Fig. 2 in that there is less restraint against flow of the metal on the outside of the bend, thus reducing the tendency for rupture from stretching of the metal. Helical coils may be made

up by this method, using a cylinder of the desired diameter and length for the bending form.

For the more difficult bends, such as small bend radii in thin-wall tubing, provision must be made to prevent distortion of the tube, and this is generally accomplished by the use of a mandrel or a filler in the tube. Fig. 4 illustrates a method in which a mandrel is employed. This is more or less a modification or refinement of the method illustrated in Fig. 3. In this method, the tubing is slipped over a floating mandrel, located between a guide block and a bending form or roller. The tube is then clamped to the bending roller so as to be drawn around it when it is rotated. By this method the bending takes place where the tube is confined by the guide block and bending roller on the outside and the mandrel on the inside, preventing any chance for distortion. The bending roller, guide block and clamp blocks are grooved to fit the outside contour of the tube, but in order to simplify the illustration, these have not been indicated.

The method illustrated by Fig. 4 may sometimes be inadequate to prevent the tube from flattening when only a single mandrel, as shown, is used. The tension in the bent portion of the tube, between the clamping block and the guide block, tends to cause distortion. For extremely difficult bends, a series of mandrels or balls, strung on a flexible cable like beads, is necessary.

Use of Fillers

For difficult bends, made in small quantities, it may be possible to bend the tube by a method such as illustrated by Figs. 1, 2, or 3, with the use of a filler in the tube. Sand is sometimes employed. Rosin, pitch, or tar may also be used, poured in the tube in a molten state and allowed to solidify before bending. These work fairly well but offer a cleaning problem to remove the material afterward. The use of fillers is quite common for jobbing work, especially for making up helical coils.

Low melting point metal fillers may also be used for bending thin-wall tubing. For aluminum tubing, Wood's metal, an alloy of bismuth, lead, tin, and cadmium, is sometimes employed. It is particularly well suited owing to its low melting point, 160 deg. F., and may easily be removed by melting in boiling water or with steam. Wood's metal may, therefore, be used with aluminum alloys in the cold-worked or heat-treated condition without impairing the properties of the material.

Wrought aluminum and its alloys become more ductile with increase in tem-

Methods of Bending Aluminum Tubing

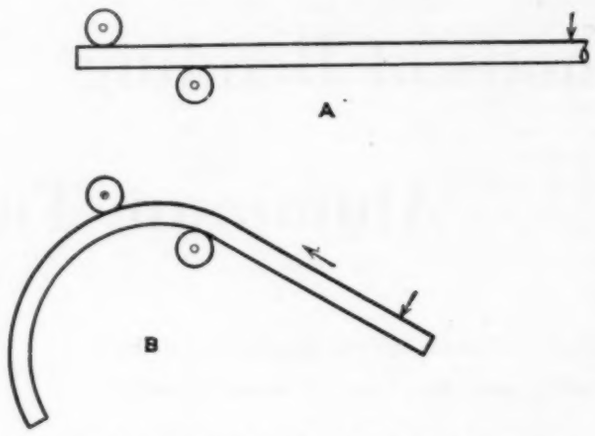


Fig. 1—One of the simplest bending devices consists of two pins in a flat plate. But the operator's skill plays a large part in the result

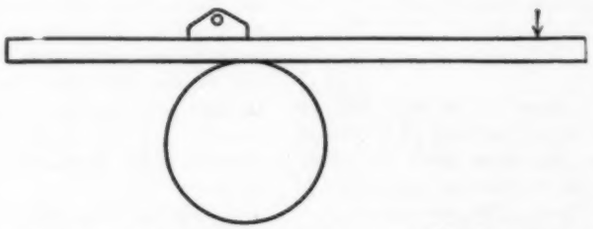


Fig. 2—A form fixes the radius; the type illustrated is often useful for simple bends

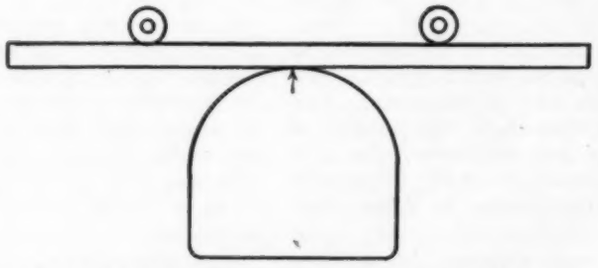


Fig. 3—With the combination of a form and a shoe, there is less chance that the tube will collapse

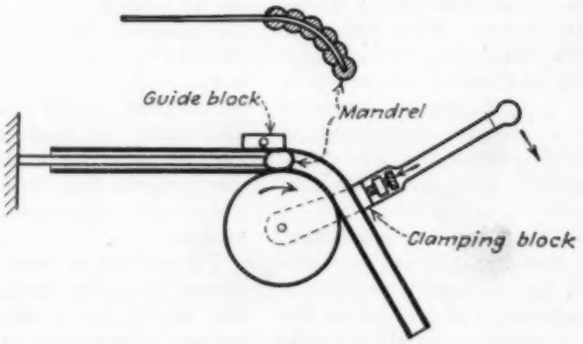


Fig. 4—Further precaution against tube collapse is obtained by the use of a mandrel

Table I—Typical Properties of Wrought Aluminum Alloys

Alloy* and temper	Tensile strength lb. per sq.in.	Yield strength lb. per sq.in.	Yield strength: tensile strength ratio	Elongation in 2 in.** per cent
2S*O*	13,000	4,000	0.31	35
2S½*H*	17,000	14,000	0.82	7
2S*H*	24,000	21,000	0.88	5
3S*O*	16,000	5,000	0.31	30
3S½*H*	21,000	17,500	0.83	6
3S*H*	29,000	25,500	0.88	4
4S*O*	26,000	10,000	0.38	20
4S½*H*	35,000	31,000	0.89	5
4S*H*	42,000	38,000	0.90	3
17S*O*	26,000	10,000	0.38	20
17S*T*	58,000	35,000	0.60	20
51S*O*	16,000	5,500	0.34	30
51S*W*	35,000	20,000	0.57	24
51S*T*	48,000	35,000	0.73	14

*O indicates annealed condition; *H*, hard worked; *W*, heat-treated and quenched; *T*, heat-treated, quenched and aged.

**Elongation values given are for 14-gage sheet. In the case of tubing, the elongation value may be more or less, depending upon the wall thickness and diameter.

perature, and in some instances, hot bending may be employed to advantage. Hot bending, however, may require more care because of the lower strength of the material at elevated temperatures, making the tube more likely to fracture if not handled carefully. Aluminum has a lower melting point than iron or copper and will melt if an attempt is made to heat it "red hot." An experienced operator may be able to heat tubing satisfactorily for bending with a blowtorch or open gas flame but this is not reliable. For close temperature regulation, a pyrometer should be used; it is desirable to use a furnace with close temperature control. The most satisfactory bending temperature will depend upon the sharpness of the bend to be made and the alloy used, and can best be determined by experiment. Hot bending of heat-treated or cold-drawn tubing should be done at the lowest possible temperature and in the shortest possible time in order to reduce the tendency to anneal the material. For heat-treated material, a temperature up to 400 deg. F. may be used for about fifteen minutes without affecting the properties appreciably. At this temperature, the ductility of heat-treated material is greatly increased. A filler such as dry sand is generally employed in hot bending.

The mechanical properties of commercially pure aluminum and of the aluminum alloys commonly used for tubing applications are given in Table I. Commercially pure aluminum 2*S*, the aluminum-manganese alloy containing 1¼ per cent manganese 3*S*, and the aluminum-manganese-magnesium alloy containing approximately one per cent each of manganese and magnesium 4*S*, may be obtained in the annealed condition or in various tempers which result from cold drawing. Of the strong aluminum alloys, whose properties are improved by heat treatment, 51*S* and 17*S* are most generally used.

Choice of Alloys

Commercially pure aluminum and 3*S* alloy are often selected because chemical requirements demand the higher purity. For many of these uses, there is little choice between the two insofar as the chemical requirements are concerned. In such cases, preference should be given to 3*S* alloy because its mechanical strength is appreciably higher and yet it has the same ductility in corresponding tempers. When higher mechanical strength is necessary, especially higher endurance strength, 4*S* alloy may be the most satisfactory. This alloy in the annealed condition is not as ductile as annealed 2*S* or 3*S*, but nevertheless, has sufficient ductility to withstand considerable bending.

No. 51*S* alloy in the "as-quenched" condition, designated 51*SW*, has been used considerably for automotive applications because of its mechanical strength. This alloy is giving way to 4*S* alloy in the annealed condition as the latter, in addition to having practically the same mechanical strength, is more ductile. Where high mechanical strength is the most important consideration, 17*S* alloy in the heat-treated condition, designated 17*ST*, is often used.

For small radius bends, where maximum ductility is desired, aluminum in the annealed condition may be the most satisfactory to use. This is especially true in the case of commercially pure aluminum and 3*S* and 4*S* alloys. It should be kept in mind, however, that the heat-treatable aluminum alloys are not generally used in the annealed condition. Therefore, it is not feasible to use the heat-treatable aluminum alloys for sharper bends than can be formed from the material in the heat-treated condition. An exception to this is in those cases in which it is practical to heat-treat the tubing after it has been bent; annealed tubing may then be used for making the bend.

Cutting Multiple Threads
Discussion

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Referring to the article under the title given above (*AM*—Vol. 75, page 673), George Odum tells how he sets the carriage for the different threads by the use of blocks of cold-rolled steel. While the correct spacing of multiple threads can be made in this manner, the slightest jar of the carriage against the blocks is likely to move them enough to spoil the work; therefore this method has been discarded for others that are more foolproof.

In regard to the use of tool bars holding cutters in multiple Mr. Odum states that the threading time can be reduced to about the time required for cutting a single thread, but that any error in spacing the tools would be transferred to the work. This method, in my opinion, is both expensive and uneconomical, for the following reasons: (a) To make a tool bar such as is suggested is an expensive job. (b) If one of the tools chips, it must be replaced before proceeding with the work, and to set another tool accurately in the bar is quite a job. Also if one of the tools should be dulled, both it and the others will have to be ground back.

In cutting an internal multiple thread with such a tool, as each tool starts cutting, the tool bar would spring slightly away from the cut, and as each tool stopped cutting at the other end, the spring of the bar would cause the succeeding tool to cut deeper, thus making the depth of the thread greater at both ends of the work than in the center. The same result will, of course, obtain when using a single tool if the operator is not exceedingly careful, but it would be impossible to avoid it in using a tool having multiple cutters. In fact, I do not think it would be possible to cut a three-start internal thread accurately if the diameter of the bore were under 3 in. or longer than 2 in. with such bars as Mr. Odum suggests.

Life of Tools on Free-Cutting Brass

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As a by-product of a study on automatic screw machines in the Brown & Sharpe laboratory during the past six years, the authors collected some basic data on tool life. This phase of their investigation is now presented

DATA on the life of a considerable number of circular forms tools is given in Table I. In all cases, the forms of these tools had been ground after the hardening operation. The maximum cutting speed is the surface velocity of the work at the outside where the tool starts cutting, while the same figure for the smallest diameter to which the tool cuts gives the minimum. In cases where the feed per revolution was changed during the cut, the weighted average is given. The feeds vary through a rather wide range, as their choice depends on the width of the cut and on the diameter of the work. A heavy, wide cut may cause excessive deflections of small-diameter stock. If an excess of time is available for forming, caused by the requirements of the turret operations, a feed smaller than the maximum may be used. In all cases, the cutting lubricant was a commercial mineral-lard oil.

The last three columns of Table I give calculated data for the average number of pieces per grind. From the work of others in this field, it was at first felt that the most significant figure would be the cutting life of the tool. This was calculated by multiplying the length of time during which the tool was cutting on each piece by the average number of pieces per grind and is given in the third from the last column. Another figure, which roughly corresponds to the amount of work done, was the total cutting depth, which is entered in the next column. This is the product of the depth of cut per piece times the average number of pieces. The third column gives the linear distance that the surface of the work moved in contact with the tool while being cut. This figure is found by multiplying the average of the maximum and minimum cutting speeds by the cutting time. Where hexagonal or square stock was being formed, the maximum cutting speed and depth of cut were based on the radial distance to the corners. No attempt was made to correct for the reduced distance on the flat sides, as it was felt that the shock of hitting the corners more than balanced the saving in wear while passing the spaces where no metal was removed.

Referring to Table I, Test 1 was a wide cut on a piece of small diameter, and this accounts for the very fine feed. A fine finish was required, which probably made it necessary to grind the form tool more frequently than on average work. Nos. 2, 3 and 4 were all on the same piece. The cut was fairly wide, and the maximum tolerance on the diameter over part of the piece was but 0.001 in. A fine finish had to be maintained as the piece was to be plated. In Test 2, a high-carbon steel tool was used, and this was replaced by high-speed steel in No. 3. A ground circular-form tool, which had been chromium plated, was used in test No. 4.

The limits were not particularly close on Nos. 5 and 6, although a fair finish was required. On job No. 7 the finish was not so important, as the formed surface had a thread cut on it by a die. Nos. 6 and 7 were made from hexagonal bars. Nos. 8 and 9 are the same piece, the first test being run with a carbon-steel tool and the second with high-speed. The stock was square, and a good finish had to be maintained on the turned surface. On No. 10 the cut was rather narrow, and a liberal tolerance was permitted on the diameter. No. 11 was similar to No. 10, except that less attention was paid to the finish, because the formed surface was later knurled.

Nos. 12 and 13 are alike in that the form tool also acted as a cutting-off tool. The back of the first piece and the front of the next were formed and the cutting-off was completed all at the same time. Possibly these two should be considered as cutting-off rather than as forming tools.

Life of the Tool

In trying to find some correlation between the results, the first thought is that the life of the tool in minutes should have some relation to the cutting speed. Frederick W. Taylor, in his "Art of Cutting Metals," found for rough-turning that the cutting speed and the life of the tool for a given feed varied by the equation $V = K / \sqrt[8]{T}$, where V = cutting speed, T = time, K = a constant.

Some of the German authorities have urged that the third root rather than the eighth should be used. Professor W. A. Knight, in an article entitled "Cutting Speeds and Feeds," published in *American Machinist* (Vol. 45, page 405) applied the results of the researches of Taylor and others to screw-machine work and suggested the use of the tenth root of the time in the foregoing equation. For any desired life of tool,

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Table I—Form Cutting

No.	Spindle, r.p.m.	Cutting, Speed, f.p.m. Max.	Min.	Feed, In. per Rev.	Average Pieces per Grind	No. of Grinds	Tool Material	Data per Grind: Cutting Time, Min.	Total Cutting Depth, In.	Linear Distance of Cutting Ft.
1	5000	314	197	0.00022	4,220	15	H.S.S.	124.5	164.5	31,800
2	2700	287	182	0.0012	3,442	12	C.S.	78.7	255.0	18,500
3	2700	287	182	0.0012	6,000	131	H.S.S.	137.0	440.0	32,150
4	2700	287	182	0.0012	6,170	38	*H.S.S.	141.0	456.0	33,100
5	2400	576	481	0.00125	3,715	15	H.S.S.	92.9	278.0	49,000
6	2400	454	294	0.0013	4,047	13	H.S.S.	165.0	514.0	61,600
7	2400	590	384	0.0023	4,760	23	H.S.S.	135.0	749.0	65,700
8	5000	462	269	0.0008	4,150	8	C.S.	74.8	299.0	27,300
9	5000	462	269	0.0008	9,680	34	H.S.S.	174.0	699.0	63,500
10	3600	570	421	0.0038	20,340	141	H.S.S.	119.0	1625.0	59,000
11	3600	602	438	0.0022	13,700	35	H.S.S.	148.5	1178.0	77,100
12	5000	164	0	0.013	69,916	24	C.S.	380.0	4370.0	31,900
13	5000	174	0	0.0018	88,652	48	H.S.S.	662.0	5900.0	57,600

*Chromium plated.

Table II—Cutting Off

No.	Spindle, r.p.m.	Cutting, Speed, f.p.m. Max.	Min.	Feed, In. per Rev.	Average Pieces per Grind	No. of Grinds	Tool Material	Data per Grind: Cutting Time, Min.	Total Cutting Depth, In.	Linear Distance of Cutting, Ft.
1	2400	392	298	0.0025	37,000	4	H.S.S.	450.0	2,700	155,000
2	2400	450	292	0.003	13,610	4	H.S.S.	231.0	1,660	87,000
3	2400	595	255	0.0033	5,474	19	H.S.S.	189.0	1,470	80,500
4	3600	382	338	0.0045	52,800	55	H.S.S.	93.0	1,510	33,900
5	3600	382	338	0.0045	30,000	5	C.S.	51.8	858	19,300
6	2700	231	122	0.0038	26,200	18	C.S.	199.0	2,040	35,200
7	3600	438	338	0.0026	66,500	7	C.S.	384.0	3,590	149,000
8	2400	392	154	0.0023	11,133	8	C.S.	383.0	2,120	190,000
9	2400	392	208	0.0036	13,300	5	C.S.	225.0	1,970	67,500
10	2400	392	208	0.0036	14,470	3	H.S.S.	243.0	2,140	73,000

Professor Knight gave, as an approximation based on the work of Taylor and others, the following equation for the relation between feed, depth of cut, and cutting speed: $V = K / \sqrt[3]{DF^2}$, where V = cutting speed, D = depth of cut, F = feed, K = a constant.

A cursory examination shows that the data given in Table I cannot be correlated by these equations. For instance, the feeds in Tests 3 and 5 are practically the same, while the cutting speed is twice as great in the latter. The life of the tool was reduced only about a third by the increase in speed, while it should have dropped to less than fifteen per cent by any of the suggested relations. Furthermore, nearly doubling the feed between Tests 5 and 7 with practically the same cutting speed resulted in an increased rather than a decreased life of tool. Similar comparison of the other tests shows that these results do not fit into the equations given.

It should be remembered that the equations referred to were all developed from tests of lathe tools rough-turning steel. In the present studies a relatively new material, free-cutting brass rod, was used. Furthermore, the tool movement is radial, a reasonable surface finish must be secured, and manufacturing limits have to be maintained. It is therefore doubtful if any equations for rough-turning with lathe tools can be adopted to this type of form-cutting.

In a further attempt to secure some correlation between the data, the last columns, entitled "Total cutting depth" and "Linear distance of cutting," were calculated. The first of these gives some idea of the tool amount of work done between grinds by the tool, while the second gives the linear distance through which the tool cut. If lapping action of the work on the point of the tool is a major factor, the last figure may be of importance, as it really gives the linear distance of rubbing of the point of the tool against the surface of the work.

An examination of the figures for "Linear distance of cutting" raises the question if this lapping action is not the primary consideration in form-cutting of this type of brass. The figures for all of the tests are fairly close together, while they vary widely for cutting time and total cutting depth. For instance, in tests Nos. 1 and 3, where finish was highly important, the values for "Linear distance of cutting" were 31,800 and 32,500, respectively. Where the finish was somewhat less important, the amounts go up, but fall rather close together, while the highest figure of all, 77,100, is for the job where the finish was of the least importance.

In the range of these tests, the average cutting speeds were changed by a more than 5-to-1 ratio from the largest to the smallest value, while the feeds per revolution varied through a 15-to-1 range. Yet, the "Linear distance of cutting" for high-speed steel tools came within a 2½-to-1 range, and this variation is largely explained by the difference in finish required.

It should be remembered that all of these tools had ground forms. It is quite possible that the same relation would not be found with tools which were finish-formed prior to the hardening operation and polished afterward. The latter type of tool is likely to have a soft film at the surface, and hence is not as resistant to the lapping action of the work.

Data Not Conclusive

While the data are not sufficiently extensive to come to any final conclusion, it appears that, within the range of these tests, variations in cutting speed and in feed per revolution have a negligible effect on the life of the tool between grinds as compared with the "Linear distance of cutting." In other words, when using a ground form tool on free-cutting brass rod, the linear distance through which the edge of the tool

Table III—Drilling

No.	Drill, r.p.m.	Dia., In.	Cutting Speed, Ft. per Min.	Feed, In. per Rev.	Feed, In. per Min.	Average Pieces per Grind	No. of Grinds	Data per Grind: Cutting Time, Min.	Data per Grind: Total Depth, In.
1	2400	$\frac{3}{16}$	350	0.027	64.8	5,750	21	71.8	4,660
2	3600	0.358	338	0.0173	62.3	22,800	21	179.0	11,200
3	2400	0.358	226	0.018	43.2	30,000	38	270.0	14,700
4	2700	0.173	122	0.030	81.0	11,260	70	92.2	8,700
4a	2700	0.173	122	0.030	81.0	13,000	6	106.5	10,100
5	3600	0.358	338	0.020	72.0	30,400	87	210.0	15,150
6	2400	0.406	255	0.022	52.8	7,200	15	77.6	4,100
7	5000	0.181	237	0.0078	39.0	72,500	5	242.0	9,420
8	2400	0.246	156	0.0153	36.7	13,290	6	305.0	11,200

contacts with the rod while cutting, appears to be the primary factor in the life of such a tool between grindings.

If the foregoing conclusion is accepted, the maximum production rate and the greatest output between tool grinds will be secured by conforming to the two following rules. First, the maximum possible feed should be used. This is limited by the power of the drive and the ability of the stock to keep from deflecting unduly under the pressure of a partly worn tool. Second, the cutting speed should be as high as possible. There is undoubtedly a limit beyond which increase in speed results in a loss rather than a gain, but it had not been reached in these tests at 600 f.p.m.

Longer Life from H. S. Steel

Another conclusion has to do with the relative merits of carbon and high-speed tools. At the time of the first tests, there was still a strong feeling among users of screw machines that carbon steel was preferable for form tools when a fine finish was required on the work. Probably this was because high-speed steel tended to deform more in hardening at the high temperature required, and the practice of grinding form tools after hardening had not been generally adopted. These tests show definitely that longer life can be expected from high-speed steel even in this field. Chromium plating was tried on one tool without causing appreciable improvement. In this case, the tool was plated but once, so that when freshly ground the top did not present a plated surface. Better results might have been secured if the whole tool could have been replated after each grinding, but this would be out of the question from a production standpoint where a single form tool was available.

The action of a cutting-off tool is similar to that of a form tool except that it does not have to leave a smooth surface on its face. On the other hand, there must always be an acute corner at the point where it finished the back of the piece cut off. This may increase the tendency to wear. Furthermore, it is essential that this corner does not throw up a burr if it is cutting to the edge of a drilled hole. Such a burr may be the factor which determines when the tool must be reground.

The record of a number of cutting-off tools is shown in Table II. The meaning of the column headings is the same as in the form-tool records. Possibly Tests 12 and 13 of Table I should be included with the cutting-off group.

In general, these tests show higher values than for forming in the "Linear distance of cutting" column. This is as would be expected, since slight wear near the point of the cutting-off tool is not as serious as on the face of a form tool. One result which is out of line is Test 4, but here there may have been a greater tendency to throw up a burr at the hole because of the high feed.

Taking the group as a whole, the advantage of high-speed steel over carbon steel are not as obvious as in the form-tool series. However, two cases are given where both types of material are used in cutting the same piece, Nos. 4 and 5 and Nos. 9 and 10. In the former there is a decided advantage in the use of high-speed steel, while it is relatively small in the latter.

While the conclusions concerning the life of these tools are not as definite as with the forming group, the data do give a considerable number of cases where high cutting speed and large feeds have been combined with long tool life.

Table III gives the data on a number of cases of drilling. Cutting speed refers to the surface velocity of the outside of the drill. The feed is given in both inches per minute and inches per revolution. The last two columns record the "Cutting time," which is given by the time spent in drilling one piece multiplied by the number of pieces per grind, and the "Total depth," which is the product of the distance drilled in each piece and the number of pieces.

In the tests reported, the feeds per revolution varied from 0.0078 in. to 0.030 in., while the feeds per minute went from a minimum of 36.7 in. to a maximum of 81 in. All of the drills were of high-speed steel. Most of them were standard twist drills designed for brass, except No. 1, which was a combination drill and counterbore, and No. 8, which was a special steep-spiral drill. There was quite an amount of breakage on test No. 4, so that the figures for 4*a* are inserted, which give the results of six successive grindings on one drill.

Cutting Speed and Tool Life

One point of interest in these tests is that large feeds can be combined with high cutting speeds and fairly long tool life can still be attained. Another conclusion is purely negative, as the tests show that high speeds are not accompanied by greatly increased wear.

A number of writers have felt that in general the relation between cutting speed and tool life in drilling was practically the same as for rough turning. In test No. 1 the cutting speed is nearly three times that of Test No. 4 and the feeds per revolution are nearly alike, yet the cutting time per grind is reduced by less than 25 per cent, while according to the theories advanced, it should have dropped over 90 per cent. This and other comparisons indicate that laws for the rough turning of steel do not apply.

While it seems impossible to deduce any law of drill life from the data of these tests, it does seem apparent that when using free-cutting brass, feeds much in excess of average practice can be used, and that high cutting speeds do not result in a rapid increase of wear.

In summarizing the results, the authors find that larger feeds and higher speeds than those used in average current practice can be combined with reasonable tool life. The type of relation determined by Frederick W. Taylor and others for the rough turning of steel does not apply to the forming and drilling of free-cutting brass. The maximum economy in machining free-cutting brass will be secured by using the greatest feed that the work and tools will stand and by running the stock at the highest spindle speed available.

Effect of Pressure Angle on Cutting Tools

SAM TRIMBATH
Gear Consultant

TO THOSE responsible for gear production the following experience may prove interesting. The conclusion, that a reasonably large operating pressure angle between cutter and work is desirable, is based largely upon experimentation, and the results are no doubt influenced by such factors as material, condition of cutting machine and rigidity of mounting. However, the accompanying illustrations show that the depth of active involute profile on the cutter was increased and a less sensitive part of the involute was used. The latter was especially interesting, as it is the contention of many gear authorities that the use of that part of the involute immediately above the base circle should be avoided. The experience indicates that it should also be avoided in the use of certain types of cutter.

The gears cut were inspected on the so-called wigglecator test, showing the tooth errors as a change in center distance. Pinion-type finishing cutters, Fig. 1, were used, and new cutters, or cutters having a diameter R, were found to produce gears that rolled more smoothly than worn cutters or cutters having a diameter R'. The impression prevailed that the cutters had lost their true form through sharpening or in the reduction of diameter from R to R'. Investigation did not bear this out despite the fact that merely substituting a new cutter for an old one would produce smoother rolling gears. In fact, inspection of the cutters upon involute testing devices showed them to be just as accurate at R' as at R, and of a high degree of workmanship, not only for form but spacing and concentricity as well.

Experimentation brought out that the questionable cutter would produce gears that tested just as smooth as ones cut with a new cutter, providing a very light finish cut was taken. This substantiated the cutter inspection, and as it was not a question of cutter accuracy, steps were taken to increase the diameter of new cutters, with a result that no complaints have been received since.

The gears were 7/9 pitch, 20 deg. nominal pressure angle, and the cutters had 21 teeth. Diameter R was originally around 3.280 in., and the questionable cutters were found to have a diameter of 3.200 in. or under. The minimum diameter R' was then set well above this figure or at 3.250 in., and while no improvement was noted at still larger diameters, it was necessary to increase R above this figure to assure ample cutter thickness.

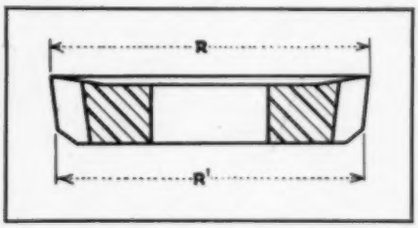


Fig. 1 — Grinding back the cutter influences the rolling action of the gears generated

The increased cutter diameter resulted in operation of the cutter and gear at a greater center distance and pressure angle. In Figs. 2 and 3, we see several differences favoring the latter. Assuming standard tooth parts for two 14-tooth gears, cutter diameters 3.400 and 3.150 in. respectively, the operating pressure angles are 23 deg. 28 min. and 15 deg. 21 min. As contact begins or ends where the outside circles intersect the line of action, the depths of active profile C in the two cases differ by a wide margin. Also the distance AB, which represents the minimum radius of curvature on the cutter, is much longer in Fig. 2 than in Fig. 3 indicating that a less sensitive part of the cutter involute was used. This is shown more clearly in Figs. 4 and 5 where the shaded cutter profiles indicate the part used below the operating pitch circle. In Fig. 4, it is an appreciable distance from the base circle, while in Fig. 5, it nearly reaches that point. A comparison of the shaded profiles for both gears and cutters also shows how the cutting action becomes concentrated on a smaller length of cutter tooth profile, as the operating pressure angle decreases. In Fig. 5, it has resulted in a smaller operating pitch circle and an increased effective addendum. The increased gear addendum being cut by a decreased length of cutter profile.

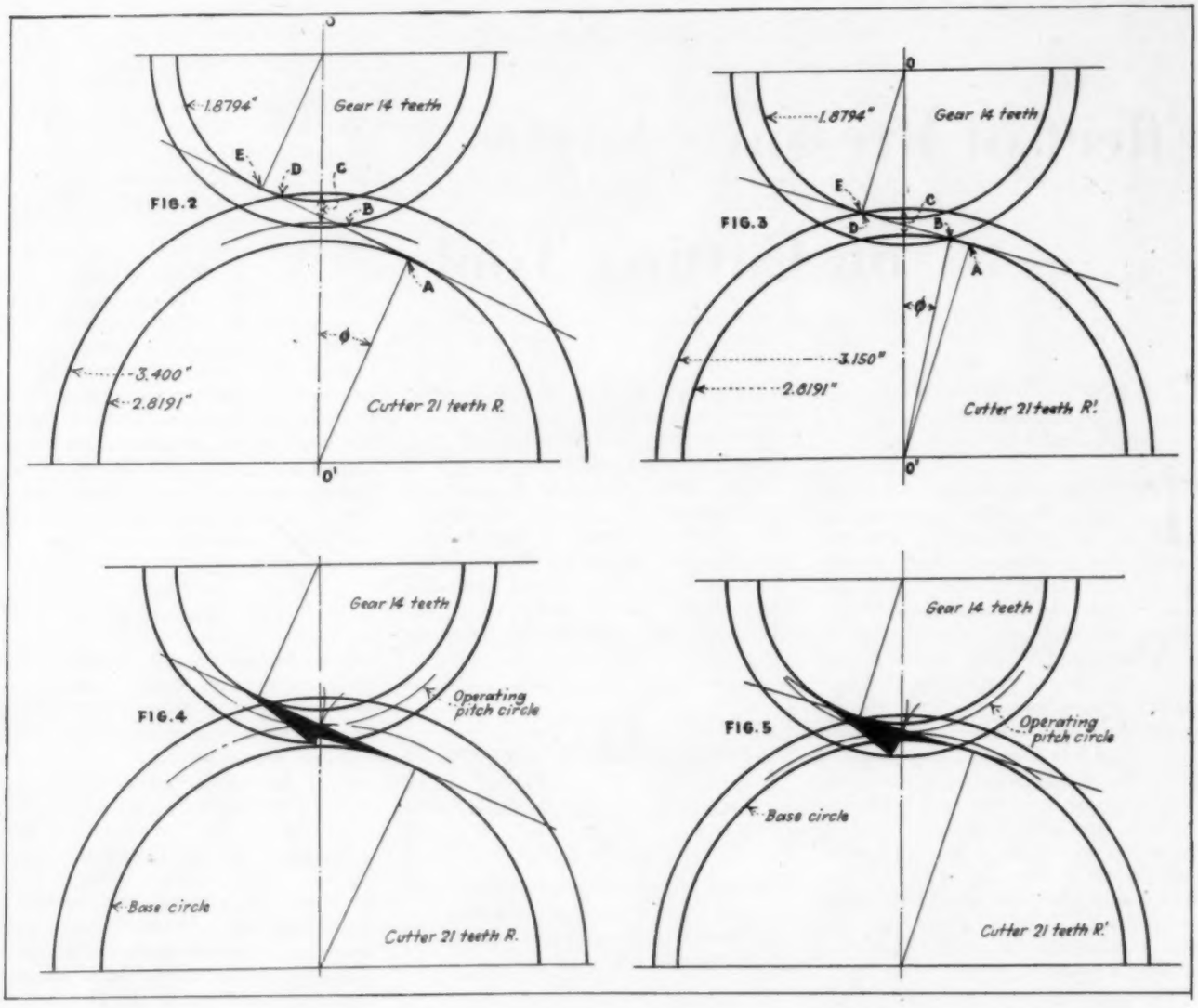
In Fig. 2, point D is where involute contact ends on the gear tooth profile, and it is evident that a gear meshing with it should not contact below this point. This depends on the number of teeth in the mating gear, line DE decreasing in length as the number of teeth in the mating gear is increased. For this reason, increasing the cutter diameter as outlined, is limited by the engaging number of teeth, and a larger cutter could be used for the 14-tooth gear if it engaged with 14, than if it engaged with a greater number.

Hobs Also Affected

It is of interest to note in passing that while a difference could be readily detected between gears cut with cutters 3.150 and 3.250 in., where the operating pressure angles were 15 deg. 21 min. and 19 deg. 6 min. respectively, the increase to 3.400 in. or a 23 deg. 28 min. angle from 19 deg. 6 min. did not show a like improvement. The results seeming to indicate that an efficient angle for generating purposes was reached at around 19 deg. If this is so, an improvement could be made in the use of hobs, for gears having basic pressure angles of less than 19 deg., by having the angle of the hob teeth somewhat greater.

Since hobs have practically straight-sided rack teeth, the operating pressure angle conforms to the angle of the teeth and remains constant throughout the life of the hob. The teeth are usually made the same angle as the basic pressure angle of the gears to be cut. However, within limitations, the teeth of the hob can be made any angle if the circular pitch is changed correspondingly. This is illustrated in Figs. 6 and 7 where two gears having the same number of teeth and the same base diameter are shown with two different angles of rack. Fig. 6 would be the conventional method, and the rack teeth would be 14½ deg., corresponding to the basic pressure angles and pitch diameter. In Fig. 7, the pitch circle has been moved to the outside diameter (a rather extreme condition made for the sake of clarity), and the angle of corresponding rack would be 29 deg. 23 min.

Here again we note that the involute cutting action has been distributed over a greater length as indicated by the shaded rack tooth profiles, but the teeth



have become so narrow across the points that it is doubtful if they would stand up sufficiently well. However, the case is rather extreme and at 19 deg. or 20 deg. this objection would not occur. Further, the gears would have less undercut with the increased angle of hob, but as outlined for pinion-type cutters, consideration would have to be given to the number of teeth eventually meshing with the 14-tooth gear.

In Fig. 6, point *D* is well within interference point *E*, while in Fig. 7 it is an appreciable distance away, although the rack teeth in both instances extend inside the base circle the same distance. The work of producing the non-active part of the profile or that part below the base circle would be concentrated upon the point of hob teeth in Fig. 7, while in Fig. 6 it would be distributed over a greater length as indicated by the shaded portion of the second tooth, but somewhere between the two extremes a better balance can be obtained. My

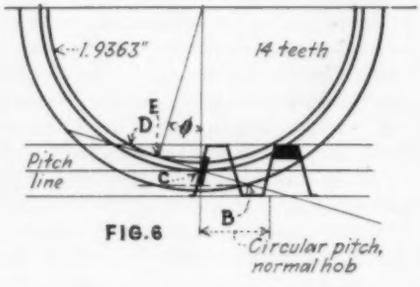


FIG. 6

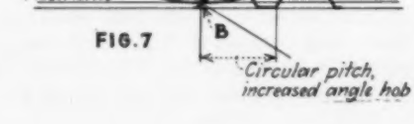


FIG. 7

experience indicates that results are better when the machining of the active profile is not concentrated upon too small a length of cutter profile, especially where the gears are first roughed out to slightly greater than finish depth, having stock on the sides only for finish cutting.

What has been said with reference to hobs could also be applied to certain types of gear tooth grinder, where the grinding wheel represents a rack tooth and the rolling cylinder the pitch diameter. Increasing the size of the rolling cylinder with a corresponding increase in angle of wheel distributes the cutting action over a greater area of wheel surface, bringing about a condition similar to that in Fig. 7. In fact, it seems highly probable that, in an operation of this kind, the width of wheel surface used in producing the active profile would be an important consideration and tend towards the use of the largest possible operating pressure angle.

Making and Keeping Crankpins Square—*Discussion*

F. M. A'HEARN

GOOD workmanship in locomotive crankpin application and maintenance, is rightly stressed by C. G. Williams and Francis W. Shaw (*AM*—Vol. 76, page 560). The first article, however, gives a wrong impression of the attitude of those responsible for locomotive maintenance. Also, it is possible that both articles imply the necessity for an uncalled for degree of accuracy in the machining operations without consideration of service conditions. In view of the foregoing, the writer considers that the last paragraph of Mr. Williams' article contains an unjust criticism when he states, "Generally speaking, considering what can be done, the actual reconditioning of crankpins and locomotive cylinders is as far behind the times as Maudslay's practice was behind today's practice. Maudslay's cylinder was 3/8 inch out of round and he developed the first cylinder boring machine to eliminate this condition."

What About the Tire?

Neither writer mentions the application of the shrunken tire to the wheel center. Should the tire be applied to the wheel center before the pin hole is bored, or is the pin hole to be bored, the pin fitted and applied and the tire set as the final operation? If the latter method is followed, will there not be, because of the "dish" or concavity of the inner contour of the wheel, a tendency to draw the outer end of the pin farther from the center line of the axle? The writer has witnessed the fracture of the outer edges of cast iron driving wheel spokes caused by excessive shrinkage allowance before the wheels were placed in service. Will not the same forces cause errors in pin alignment? Assuming that tires are first applied, after which pin holes are bored and pins pressed in, will not any subsequent loosening or resetting of the tire alter the relation of the pin to the axle center line? Again, has the unequal distribution of the hub metal surrounding the crank pin been considered by Mr. Williams as a cause for distortion while pressing in the crank pin? If so, it is not mentioned and may be unimportant, as by using the method he describes, he can keep the alignment error of the pin within 0.005. Considering the make-up of a pair of locomotive driving wheels, an error of 0.005 in. couid be disregarded.

The majority of locomotive shop men are familiar with all the possibilities mentioned in the preceding paragraph. Also they fully realize that any or all may contribute to producing pin alignment errors but that slight errors are permissible because of the construction and working conditions of the assembled locomotive.

For example: Locomotive driving wheels in pairs are assembled together with their bearings in the frame pedestals in such manner that any individual pair of wheels may move up or down in relation to the locomotive frame in order to support through the spring rigging their proportion of the weight of the machine. Also, in passing over inequalities in track surfacing, an individual wheel will raise or lower while the opposite wheel and axle center move in a horizontal plane. The vertical movement of driving boxes varies in relation to the frame assembly, the amount of course being proportional to the surfacing of the track. In any case, under actual operating conditions, the variation between the horizontal center line of the main pin and the horizontal center line of the crosshead pin is substantially in excess of 0.005 inch and may even be 0.05 inch in the length of the main rod bearing on the main pin. Realizing this, as well as that the overhung position of the main rod bearing on the main pin of necessity causes some spring in the driving axle, as well as in the pin itself, and also that shoe and wedge wear, as well as axle bearing wear, is ever present, we may readily assume the maintenance man may consider such refinements as pins reground within limits of 0.005 inch as mentioned by Mr. Williams to be uncalled for. Regrinding pins worn but a few thousandths is not necessary, and it is more satisfactory to recondition all pins at the time that the locomotive is undergoing classified repairs.

While it is admitted that a locomotive crankpin may be cut or overheated to such an extent as to require renewal without waiting for the locomotive to receive classified repairs, the writer has never seen a pin worn 1/8 inch out of round during the interval between classified repair periods. It should also be borne in mind in connection with this discussion that the limit of wear for main pin bearings is 1/32 inch. In other words, the maximum difference between the bearing diameter and the pin diameter shall not exceed that amount. This limit is standard on all railroads in the United States.

Obviously it would be impossible to keep bearings within the prescribed limits with the pins 1/8 inch out of round. To find a pin worn out of round 1/8 inch between shoppings is an unusual condition, and one that demands something more than precision machinery in the shops. In such cases, investigation of wheel base tramming methods of lubrication practices may bring prompt and permanent relief.

Fuel Savings Remote

The fuel saving possibilities mentioned by Mr. Williams may be somewhat remote when consideration is given to features not mentioned in connection with the description of a machine which may be set up in ten minutes and a worn pin reconditioned in another ten minutes. This is a good record. However, the writer omitted mention of the labor cost of removing, rebushing, and replacing the rod of the locomotive, as well as the loss of the service of the locomotive while held for the repairs mentioned.

The incident of a cylinder being bored 1/32 inch out of round probably was caused by ignorance or carelessness on the part of the mechanic intrusted with the job. We hesitate to believe that any railroad shop knowingly makes a practice of supporting a locomotive on the cylinders while the cylinders are being bored. The results are too well known by shop men.

Railroad shops, like all shops, offer many opportunities for improvement. As a class, those responsible for their operation are constantly trying for better results and also are in a receptive attitude towards advanced ideas. Constructive criticism is beneficial. On the other hand, criticism without an understanding of the subject or without stating pertinent facts, tends to be misleading and consequently unjust.

Courtesy Worthington Pump & Machinery Corp. *Photo by Rittase*

Just another operation, yet each falling chip

embodies the romance of man's conquest over metal

EDITORIALS

AMERICAN MACHINIST
VOLUME 76 ESTABLISHED 1877 NUMBER 26
McGRAW-HILL PUBLISHING COMPANY, INC.
K. H. CONDIT F. H. COLVIN
EDITORS

The Same—But Better

In planning a new *American Machinist* the interests of the readers are naturally fundamental. These interests, established by careful study, are six in number: (1) The same high standards of editorial policy, content and appearance; (2) Readability; (3) Practical usefulness; (4) Industrial or commercial interest; (5) Human interest; (6) Technical interest.

To construct a paper that coincides with these reader interests we plan a continuation of the kind of editorial service that has characterized the *American Machinist* for fifty-five years. In other words, the subscriber whose reading habits are more or less fixed will find in the new paper just about what he has been accustomed to expect, but refined and improved to meet present-day needs.

A more readable paper. To this end a newly cut font of Scotch-Roman type has been purchased and will be used throughout the editorial section. It is a stronger, blacker, more masculine type than the old one. Along with this type will go a heavier weight of line in the line drawings used for illustrations that will make them easier to read and more in line with modern drafting-room practice.

Emphasis on the more practical features of the paper, which are doubly valuable in times of stress. Shop Equipment News moves over to the back of the editorial section where it gets adequate space and doubly careful editing. Ideas From Practical Men come just ahead of Shop Equipment News and are down for at least six and usually seven pages each issue. Reference Book Sheets will be located just back of the News and there will be one or two of them in every issue depending on the subject treated.

Industrial interest. Our contact and correspondence with readers has convinced us that they look to *American Machinist* for high-spot news and comment on business and industry rather than for extended treatment. Hence the five pages in the center of the book, of which this Editorial page is the first, will stick to brevity of expression, and will contain most of our business comment. Chips follow editorials, and then come the industrial review and the carefully selected news of industrial men and affairs.

Human interest. The thousands upon thousands of comments and criticisms on the doings and opinions of Al and Ed, and of the various characters of the Executive Forum, prove beyond the shadow of a doubt that readers of this paper are human first and technical afterward. Human interest will therefore be given primary consideration in every issue we put together. We are making a change in the Foreman's Round Table and the Executive Forum which we believe will be a welcome one to every follower of those departments. Details on page 828f.

Technical interest. When all is said and done, *American Machinist* is essentially a technical periodical. It always has been, and always will be, so far as we can see now. Its readers have many interests but they read it because of its technical authority. We are jealous of its reputation for technical accuracy and authority and we shall continue to make the maintenance of that reputation our first concern.

One of the real joys of editing *American Machinist* has been the friendly criticism that has come to us by mail, by telephone and by word of mouth from readers who subscribe, from readers who do not subscribe, and from readers who advertise. We hope that *American Machinist*, 1932 Model, will so appeal to all of these readers that they will continue their comments and thus help us to make this paper a better one for their practical use. We want them to feel that this is the same *American Machinist*—but better.

Gadgetless Machines

Impending announcements of so-called gadgetless cars are evidence that motor car makers have accepted the fact that purchasing power per customer is painfully less, and that performance is more popular than luxury just now. Is there a hint in this decision that other machinery builders should take? Should they too recognize that, appreciative as most of us are of the refinements of craftsmanship and the perfection of detail, more of us are facing the hard truth that we can afford just so much, and no more? And that we would rather have something not quite so perfect that will meet our immediate needs than something that adds expensive talking points to its appeal but does not perform very much more satisfactorily?

The Handicap of Tradition

Tradition is a two-edged sword, especially in industry. Often, it is simply another name for inertia and provides an alibi for lack of progress. In the days when cast-iron was the predominant metal in all sorts of machinery, the plant centered around the foundry. Some of us have not learned yet that other metals offer greater advantages for many parts.

In one case of this kind, competition made it seem advisable to put out a pressed steel product as well

as the old standard design in which cast-iron played the major part. But instead of using the same good sales methods that had built up the business to large proportions, the new product was priced at a prohibitive figure with the idea of favoring the old machine. The result was to divert customers from the old machine to a steel product built by another concern but priced more reasonably. The attempt to protect the foundry lost trade on both the old and new products.

Traditions of quality and fair dealing are highly commendable. But when they are perverted to mean sticking to old materials and old methods, and to prevent following the trend of the times, they are a handicap of no mean size. Absence of tradition frequently means an open mind to see and grasp new ideas, and accounts for the success of companies that have grown from small beginnings.

CHIPS

Summer stagnation is upon us . . . plants close, vacations with pay, part pay, no pay are the rule . . . Although some business indicators reach new lows, the general average has changed little in 3 months . . . possibly the bottom has been reached and the next move will be upward . . . more and more people are beginning to think so and to say so out loud . . . Small businesses, finding that they cannot hope to drown out the whines of their big competitors, are giving up the effort and going out and taking business away from the old leaders . . . find it much more profitable activity.

Wholesale prices rise . . . carloadings increase . . . so do numbers of car and locomotives in need of repair . . . automobile shipments good but the small car builders get most of the business . . . Federal Reserve Banks of N. Y. and Chicago reduce rates to 2½ per cent . . . London rate at 2 per cent . . . Dire national and international calamities forecast for June seem to have been thoroughly discounted . . . or they failed to materialize.

Democratic platform model of brevity . . . repeal plank positive . . . leads to orders for brewery machinery and equipment . . . Meanwhile Congress passes reduced appropriation bills . . . relief conferees lean toward opening loans to private industry . . . President reluctantly signs economy measure.

Moratorium, lump sum final reparation payment, reconstruction pool raise hopes at Lausanne . . . must be approved by governments . . . Japanese jingoes think less than nothing of Hoover arms reduction plan . . . other nations rather favorable to it . . . German Junkers to muzzle opposition press . . . Siam, last stronghold of absolutism, puts on a perfect revolution . . . all aims accomplished in a way that should cause envy in Latin America and Central Europe . . . King's vacation singularly well scheduled.

Soviets will buy $75,000,000 of goods, mostly machine tools from Germany in next year . . . 20 per cent down, average 20 months to pay . . . Reich carries 60 per cent instead of old 70 . . . Russia cancels expert's contract with G. E. . . . will continue purchases . . . International Tin Committee limits output further, effective July 1 . . . Germany moves on toward state capitalism through purchase of big block of Gelsenkirchen stock which carries control of steel trust with it . . . "to prevent foreign banks from getting it" . . . price per share threatens scandal . . . Von Papen cabinet helps local gasoline industry by reducing tax to 5 pfennigs a hundredweight . . . keeps 5 marks on imported oil . . . consumers and labor not too happy . . . British automobile industry only slightly behind 1931 in sales . . . export sales for last 5 months up 50 per cent.

Young Committee of N. Y. Federal Reserve District comes out strongly in favor of wide use of the trade acceptance . . . Iron and Steel Electrical Engineers hold enthusiastic convention with timely exhibits . . . Food machinery manufacturers decide not to exhibit at Chicago canners' convention in January . . . Idle radio engineers being organized to approach their local plants with suggestions for improving production processes and equipment by installation of electronic tube control . . . $10,000,000 Hoover Dam welded pipe line held up by threat of patent infringement suit . . . bids may be readvertised on new specifications . . . Bankers holding up power plant modernization projects that would liquidate themselves in less than two years . . . Process industries in fair shape . . . several new projects, including big Titanium Products plant in East, under way . . . Conveyor and coal cleaning equipment being bought in anthracite regions . . . settlement of labor troubles in Illinois and Indiana will clear way for considerable needed equipment purchasing.

Interest in gold mining booming . . . some machinery buying sure to follow . . . practice of building small pilot plants to test out new properties preliminary to full-scale development is growing in favor . . . New copper tariff beginning to hurt . . . means loss of much refining business which will go to new British and Canadian plants . . . Street railway companies extensively engaged in modernizing cars in their own shops . . . N. Y. City Board of Transportation setting up new machine tools in shops of municipal subway . . . Activity of appraisal engineers in textile mills an augury of machinery orders in future.

Bigwin A.S.M.E. Meeting Featured Metal Working

Machinability of forgings upset from coarse-grained steel is much better than similar forgings produced from finer grain material, and, moreover, the density and durability of the product is improved by use of coarse-grained stock. These findings were reported at the semi-annual meeting of the American Society of Mechanical Engineers, at Bigwin, Ont., by F. W. CEDARLEAF, works manager of the Muncie Products Div. of the General Motors Corp. and W. E. SANDERS, plant and metallurgical engineer of the same company. Authors of the paper "Researches on Steels and Forgings for Greater Density, Machinability and Durability," discovered that voids or cavities in forgings indicate slipping or tearing of the fibers of the metal, and that these conditions were more pronounced in specimens made from steel having finer grain size. It was also found that ductility of the coarse-grained steel makes it possible to obtain greater density in upsetting and to pierce smaller holes of greater depth or length. Life of gears was found to have been increased 50 per cent by this discovery.

Several other papers of interest to the metal-working industry were on the technical program. One investigation, "Life of Tools on Machining Free-Cutting Brass" by L. D. SPENCE and JAS. A. HALL is reported in full on page 822 of this number. Since the meeting was intended to reflect the engineering practices in three countries, two British authors, C. G. BAINBRIDGE and HENRY E. MERRITT contributed respectively "Oxygen Machine Cutting in Great Britain" and "Developments in the Design and Application of Gearing." Design engineers in the railroad field heard "Design of Anti-Friction Bearings in Railroad Rolling Stock" by T. V. BUCKWALTER. For those interested in management problems there were "Current Problems of Industrial Management" by JAS. D. MOONEY and "Is There Any Basis Left for the Taxable Value of Manufacturing Properties" by CHAS. T. MAIN. Sessions running from June 28 to July 1 were conducted by the various divisions of the society.

Tariff Committee Organized in London

To assist American exporters in obtaining relief from British tariff duties, particularly on highly specialized machinery, the American Chamber of Commerce in London has organized a tariff committee. This committee, of which Lawrence Tweedy is chairman, is in contact with the Import Duties advisory committee that under the finance bill now pending in Parliament, would be authorized to recommend whether consignments should be exempted from additional duty or from all duties.

The advisory committee's suggestion to Parliament evidences a change in the British attitude since the imposition of the temporary duties.

"It is undoubtedly true that our imports comprise certain very specialized kinds of machines which are not produced here," the advisory committee's recommendation reads: "Indeed some are so highly specialized that the whole world demand is easily met by one factory and any attempt to set up a separate productive unit in this country in such a case would obviously be wasteful. We have little doubt that we shall in time be able to prepare more detailed schedules. For the present, at any rate, we are of opinion that some arrangements of an elastic or discretionary nature are required to insure that no avoidable handicap is placed in the way of users in this country in this regard."

The American chamber has issued an announcement stating that no case will be considered worthy of presentation unless it can be shown: (1) that the machinery of the type covered by the application cannot for the time being be procured in England; (2) that it cannot be economically manufactured in England; (3) that British users must have these machines to insure efficient operation.

Young Committee Indorses Trade Acceptances

Announcement of a plan to broaden the use of trade acceptances has been made by the Young committee of bankers and industrialists. Substitution of trade bills for open book accounts forms part of the campaign for better business methods. It is the belief of the committee that extension of this plan will lead to the use of additional bank credit, to the increased movement of goods and raw materials and to greater employment in industry.

Proper extension of the use of their facilities to bring about enlargement of the trade acceptance program has been recommended to the American Acceptance Council, the National Credit Men's Association and the Federal Reserve banks. The sponsors of the plan believe that trade bills, bearing two good indorsements, will find a ready market.

Although the rates at which acceptances will change hands is still in doubt, manufacturers and banks have manifested keen interest in the proposal. It is expected that the idea will readily take shape and that within a week the new bills will make their appearance.

• INDUSTRIAL REVIEW •

With but few exceptions machine tool and machinery builders and dealers manifest a strong feeling of optimism toward autumn business. Everyone is convinced that few orders will be placed during July and August, except possibly in connection with the introduction of new models in the automobile field.

Chicago has been struggling with a banking crisis that has effectually dampened any enthusiasm for machinery purchases, but is now recovering. Small tool sales, which have been fair, have fallen off sharply. Pittsburgh employment is at a minimum. Steel mills accumulate enough orders for a few days of efficient double-turn operation, start up, run off the orders and shut down again. Railroad men are discussing the wisdom of abandoning their old policy of manufacturing parts and complete units. New England finds small forces working two or three days a week with little encouragement ahead. Philadelphia sees much the same situation.

Detroit reports a June drop in machinery business, which seems to include all lines, of about 25 per cent, although Ford and Chrysler are doing better than had been anticipated. Sales of welding equipment prove its growing popularity. Small tool demand is poor but shelves are empty and purchases must be made soon. Cincinnati is experiencing somewhat better feeling, although employment in machine tool plants is at a new low and one of the few orders placed was for rebuilding machines. Some companies got better inquiries in June. Indianapolis always suffers through withdrawal of work in dull times from its shops which are branches of Detroit companies, and the present is no exception. Local motor truck companies and some parts concerns have been going fairly well. New York continues to report almost no business.

Supervisors and Foremen Plan Silver Bay Programs

Further details have been made available concerning industrial conferences to be held mainly in the interests of the smaller companies at Silver Bay-on-Lake George, N. Y., over the period July 8-22. Besides the program of the second annual conference on management problems (*A.M.*—Vol. 76, p. 804f), three other divisions of the Silver Bay Institute plan meetings. The supervisors division will undertake two periods from July 8-14 and 15-22. Three major topics will be attacked: cooperation and coordination of manpower; coordinating equipment and materials, and survey of operations for possible improvement. Recognized experts in various phases of supervisory work will aid in the discussions. The plant training division will undertake conferences on: foreman training; training plant instructors; organization of plant training, and approaches to training problems. W. H. NELSON, General Electric Co., Schenectady, will be chairman. The personnel division will meet from July 8-22, and will seek to emphasize the fundamental principles of personnel administration in the light of the entirely different conditions prevailing now as compared to those of only a short time ago. Representatives of several of the larger corporations are cooperating in the program.

Chapman Elected A.S.T.M. Head

At the thirty-fifth annual meeting of the American Society of Testing Materials, held at Atlantic City, N. J., June 20-24, CLOYD M. CHAPMAN, consulting engineer, was made president for the coming year. W. H. BASSETT, nonferrous metallurgist, was named vice-president.

C. A. MENZEL, associate engineer, Portland Cement Association, received the CHARLES B. DUDLEY medal, which is awarded to the author of the most valuable paper presented before the society during the preceding year. Professor HUGH STOTT TAYLOR, of Princeton University, delivered the EDGAR MARBURG lecture; his subject: "Fundamental Problems of Resistance to Deterioration." The meeting was opened by F. O. CLEMENTS, retiring president.

Of interest to the metal-working industry were many of the papers and committee reports. The symposium on steel castings, held jointly with the American Foundrymen's Association, resulted in the presentation and discussion of eight papers on the design, properties, heat-treatment and development of steel castings as well as a general survey of the industry. During the session on steel, its magnetic properties were discussed. Other topics were wire rope, pipe and tubing, deoxidation and sheet metal gages. The session on wrought and cast iron brought out the effect of temperature on tests, deformation in gray iron and embrittlement of malleable

CLOYD M. CHAPMAN
New President of A.S.T.M.

castings. Hot-galvanized structural steel, tests for zinc coatings, fatigue of shafts having keyways and fatigue failure under repeated compression received attention during the session on corrosion and fatigue of metals. The non-ferrous group discussed the effect of cold-working on monel metal, recrystallization and grain size of non-ferrous alloys, and the physical properties of cast red brass. Among the general papers of particular interest were those on the acquisition of good data.

Standard for Welding Hose Connections

A recommended commercial standard for hose connections for welding and cutting torches has been submitted to industry for approval by the Department of Commerce, Bureau of Standards. The recommended standard is distributed at the request of the National Screw Thread Commission which established the specification in 1928, and which desires the establishment of the specification on commercial standards with a view toward increasing effectiveness and more general use.

Gray Cast Iron Specifications Completed

As the result of several years research work by the Gray Iron Institute, Cleveland, Ohio, the old specification for gray iron castings known as A48-29T was revised last week at Atlantic City by the American Society for Testing Materials to a tentative form known as A48-32T. Two new features of interest are:

1. Classification of gray iron into seven tensile groups was made. (20,000, 25,000, 30,000, 35,000, 40,000, 50,000 and 60,000 pounds per sq.in.).

2. Tensile and transverse bar sizes for standard testing were increased in number from one to three (.875, 1.2 and 2.0 in. diameter) in order to provide adequate design information pertaining to various sections in castings.

It will now be possible for foundrymen to state specifically the strength which can be expected in critical sections of their castings. Heretofore, the single arbitration test bar has not given results which could be applied satisfactorily throughout the whole range of section sizes. A Certification Plan is being worked out whereby any foundry submitting its iron to suitable tests and metallurgical inspection of these results can certify that its product fulfills the requirements for one of the above classes. It is expected that orderly marketing of gray iron castings will result from this project.

Metal Congress Papers

During sessions of the American Society for Steel Treating during the forthcoming National Metal Congress to be held in Buffalo during the week of October 3, not more than three papers will be scheduled for any one of the nine sessions in order to permit more time for written and oral discussion. A list of titles of papers tentatively scheduled follows:

Experiments on Steel Forgeability.
A Simple Tool for Measuring Pressures in the Direction of Cut
Scaling of Steel.
Transformation in the Carbide Phase During Graphitization.
New Developments in Nitriding.
Creep Characteristics of Metals at Elevated Temperatures.
Effect of Sulphur Gases on Scaling Steel in the Forging Range.
Drop Forging Practice.
Forging Furnaces and the General Problem of Heating Forging Steel.
Development and Application of Deep Etching.
Preparation of Specimens for Deep Etching, Etching Reagents, Time and Temperature of Etching.
Interpretation of Structures as Revealed by Deep Etching.
Deep Etchng as an Inspection Method in a Steel Mill.
Critical Ranges of Iron-Carbon Alloys.
Field Search for Age Hardening Alloys.
Inspection and Testing of Sheet Steel.
Lubrication of Deep Drawn Sheet Metal Parts.
Annealing of Cold Rolled Strip Steel.
Internal Friction as a Physical Test for Metals.
Hardening Transformation in Fe-Mn-C Alloys.
Effect of Normalizing Medium Manganese Steels on the Miscrostructure and Physical Properties.
Tungsten-Cobalt System.
Effect of Gas in the Hardening of High Speed Steel.
Molybdenum High Speed Steels.
Corrosion Resistance of Chromium-Iron Alloys in Various Media.
Design of the Heat Resisting Alloy Furnace Parts and Their Performance in the Field.
Manufacture of Stainless Alloys.

•BUSINESS ITEMS•

The Simmons Machine Tool Corp., with main offices at Albany, N. Y., will open a new warehouse for rebuilt machine tools to serve the Metropolitan area. Location of the warehouse will be in Jersey City at the entrance to the Holland Tunnel. All kinds of used machinery and accessories will be displayed there ready for shipment. Rebuilding of the machines will be undertaken at the Albany plant.

The Construction Machinery Co., Waterloo, Iowa, has filed articles of incorporation to manufacture building machinery with a capital stock of $100,000. P. L. BRYANT is president, L. B. BRYANT, vice-president, and L. S. HOLDEN, secretary-treasurer.

The Federal Machine & Welder Co., has announced that it has secured the services of ARTHUR MALLETT, formerly chief engineer of the Thomson-Gibb Electric Welding Co., Bay City, Mich., and also those of CLYDE COATES, formerly designing engineer for the Taylor-Winfield Corp.

Assets of the Connecticut Electric Mfg. Co., Bridgeport, will be sold to the Connecticut Products Corp. for $175,000. The latter company is associated with the Industrial Management Corp., New York.

Piston Ring Manufacturing & Distributing Co., San Francisco, has been organized to manufacture piston rings for steam and diesel engines. H. H. HOPKINS is manager and J. E. RICHLIN is shop superintendent.

Shops for the repair and maintenance of all types of aircraft are to be installed at the Alameda Airport, Alameda, Calif., Pacific-Coast base of the Curtiss-Wright Airport Corp.

Acme Forge and Steel Co., 5 Zeno Place, San Francisco, has been organized to specialize in steel forgings and alloy steels.

The American Radiator Co. reopened its Buffalo plant on June 28 and recalled 250 employees.

• OBITUARIES •

EDWARD DUNN, 53, master mechanic of the International Nickel Co., died suddenly at his home at Port Colburne, Ont.

HERMAN ISAY, 62, vice-president, secretary and treasurer of the Allegheny Foundry Co., Inc., Pittsburgh, died at Hammond, Ind., June 22.

CHARLES J. MCPHERSON, manager of sales since 1927 of the J. G. Brill Co., car builders, Philadelphia, died of heart disease June 20, aged 46. Before joining the Brill Co. in 1913, Mr. McPherson had been associated with the American Car & Foundry Co. and the Baldwin Locomotive Works.

HARRY F. OBERHELMAN, president of the Eastern Machinery Co., Cincinnati, Ohio, died June 15. He had been well known in the second-hand machinery business through an association with it of 17 years.

WILLIAM E. POOLE, formerly general superintendent of the N. Y. Insulated Wire Co., plant at Wallingford, Conn., died in that city, June 24. He was 59 years old.

JOHN R. POWERS, 59, of the Powers Belting & Machinery Co., Racine, Wis., died recently.

WILLIAM ROWAN, JR., secretary and treasurer of the Morton Mfg. Co., Muskegon Heights, Mich., died June 14.

JOHN WALKER, last of the four pioneer industrialists in the Pittsburgh iron and steel industry, died June 24 at the age of 88. In 1872 Mr. Walker helped to organize Wilson, Walker & Co., which acquired the lower mill of Union Mills Company. He retired as chairman of Carnegie, Phipps & Co., a forerunner of the Carnegie Steel Co.

• PERSONALS •

EDWIN H. BROWN, mechanical engineer, A. O. Smith, Corp., Milwaukee, has returned from a business trip of 7½ months in France, Germany and Russia.

JOHN H. CHAPLIN, formerly secretary of the Veedor-Root, Inc., Hartford, Conn., manufacturers of registering and counting devices, has been elected vice-president to succeed the late EDWARD H. CROSBY. CHARLES E. ALLEN succeeds Mr. Chaplin as secretary. He has been with the company for 25 years.

JOHN W. GOETZ, for twelve years assistant to the president, National Industrial Conference Board, has been appointed managing director of the American Management Association, to succeed W. J. DONALD. Before joining the conference board, Mr. Goetz was for several years with the General Electric Co.

E. K. HUBBARD, 3RD, has been elected secretary and treasurer of the Chance Vought Corp., East Hartford, Conn. He has been connected with the company since May 1.

F. M. KINTNER, vice-president and director of research, Westinghouse Electric & Mfg. Co., East Pittsburgh, received the honorary degree of doctor of engineering from Purdue University, Lafayette, Ind., at the commencement exercises held on June 14.

H. L. RANDALL, president of the Riverside Metal Co., Riverside, N. J., recently returned from a business trip to Europe.

E. E. RUSSELL, of the J. I. Case Co., Racine, has been elected president of the Milwaukee Association of Purchasing Agents. Other new officers include SAM WILSON, Kearney and Trecker Corp., vice-president; E. O. JONES, Bell City Malleable Co., secretary; D. I. HARTIAN, Oilgear Co., national director.

HENRY D. SHARPE, Brown & Sharpe Mfg. Co., Providence, Class of '94, was elected twelfth chancellor of Brown University on June 21.

DR. JOSEPH SLEPIAN, consulting research engineer, Westinghouse Electric & Mfg. Co., received the John Scott medal, certificate and premium of $1,000 on June 13. Dr. Slepian's citation refers to conspicuous work in circuit interrupting devices and the use of his unique principle of deionization and the destruction of powerful and violent electric arcs.

H. WILMOT, formerly production manager for the Arrow Hart Hegeman Co., Hartford, Conn., has been elected treasurer of Colgate University, Hamilton, N. Y.

• MEETINGS •

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. National Machine Shop Practice Meeting, Buffalo. Week of Oct. 3. Calvin W. Rice, secretary, 29 W. 39th St., New York, N. Y.

NATIONAL METAL CONGRESS & EXPOSITION. 174th Regiment Armory, Buffalo, N. Y., Oct. 3-7. Sponsored by A.S.S.T., with cooperation of A.S.M.E., Institute of Metals and Iron & Steel Divisions of A.I.M.E., A.W.S., and the Wire Association. W. H. Eisenmann, 7016 Euclid Ave., Cleveland, Director.

SILVER BAY ASSOCIATION. Silver Bay-On-Lake George, N. Y. Plant Training Division, July 15-22. Supervisors Division, July 8-22. Personnel Division, July 8-22. Smaller Plants Division, July 15-22. Silver Bay Industrial Institute, 347 Madison Ave., New York, N. Y.

THE ROUND TABLE

It takes nerve to launch a new venture these days, yet in almost every community a few brave spirits are cutting their ties with the past and risking all on a new idea, a new product, or a new partnership. Al is on the verge of embarking on such a venture. When and if he does he ceases to be a foreman and becomes a proprietor. Consequently, his talks with Foreman Ed will take on a somewhat different complexion. And so we change the name of the old Foreman's Round Table to The Round Table, and we merge with it the old Executive Forum.

A feature of the change will be a certain continuity in the story of Al and Ed which has not been attempted heretofore. We believe that this will be welcome to the many followers of the doings of Al and Ed, and we shall welcome the comments and criticisms that have made the old Forum and Round Table places for the free expression of opinion and conviction.

The Editors.

Is This a Good Time to Quit?

"Ed, do you know what? I think I'll quit."

"Say that again Al, and say it slowly. You think you'll what?"

"I think I'll quit. I'm fed up with the deadly monotony of this inactivity. I think I'll go in business for myself. I can at least raise a lot of dust going after business even if I don't get any. Here I have to wait and hope that it will come. Another thing—the happiness of too many families rests on my shoulders for me to rest entirely easy at night. I never know when I'll have to lay off more men and bring hardship on their families. It's tough Ed, so I've about made up my mind to quit."

"You're feeling blue, today, Al. Use your head. Suppose you do quit. Do you think anyone can or will do more for your men than you do? They might even shut down your department entirely. Besides, how about yourself. What will you do? There are no foreman's jobs now."

"I don't want another foreman's job. I'm tired of working for other people."

"Yes, so'm I. But what could you do?"

"Lots of things. Do you remember that man Mason that came down to see me a few weeks ago? Well he's a good engineer. He's perfected a rotary compressor that takes care of all the objections, usually made against that type. Many concerns have been looking for a compressor that will not take up much room. It only needs commercial development now."

"Yeah, lots of inventions have reached that stage, and they seem to stick there. That has been particularly true of rotary compressors. Maybe Mason's would do the same?"

"I'd have to take a chance on that, but his mechanical development has been so thorough and so consistent that I'm not afraid. In the meantime we have in mind some items and tool work as a pot boiler. I haven't given Mason a definite answer yet, but he's a mighty good man, and I would be fortunate in getting in with him. It's a temptation I tell you."

"Sure it is. I'll agree to that. But don't forget, nearly every mechanic has that same itching or yearning. How many do you know of that have gone into business for themselves and busted? I know two from this company and so do you."

"Yep, and I know that they went into business at a time when you could sell anything, too. That's what you were going to say, wasn't it? I know all that, Ed, and I know too that that is the wrong time to go into business. You have the idea that you can't fail and don't take any precautions against it. I know that if I go in at this time the chances would be against making good. If I did it would be because I worked like the devil. I would go in with that idea. If you start at the worst possible time, things must get better, because they can't get worse."

"Well, that's some satisfaction, anyway. We all get the fever, Al. I wanted to quit once and go into the hardware business. Remember the time? And remember how you argued with me and came over to my house and talked until near midnight?"

"Well, that wasn't the right kind of business for you, Ed. Times were too good. You would have neglected business to go fishing, and left it for your wife to tend to. It wasn't a woman's business. I'm different. Times are hard, and we'd be up against it from the start. I don't like to fish, neither does Mason."

"What'll the wife say about it, Al?"

"I don't know, Ed. I guess I'll face that problem tonight."

Is Al's argument about quitting in hard times, sound? Is any successful foreman justified in quitting a good job at this time for a problematic better future?

Discussion

Rolling Stones

The rolling stone gathers no moss, but it surely has the corners rounded off. The apprentice is full of sharp corners. The finished mechanic has these corners slightly rounded. The foreman has had the rounding process carried further and so on up. The amount of time it takes to round off those corners depends on the material of which the stone is composed. Sandstone corners round off fast. Building stone more slowly and so on to marble and granite. Some men apparently round off at thirty years, others at forty, and still others at later points in life. Most of our executives of thirty years of age are out of the picture at forty. Generally the fifty year executive does not pass out of the picture till he is seventy or so. Did you ever see such a crumbling, such a smashing up of sandstones as has been in progress since 1929? Instead of the corners rounding off, they break off and the cracks go on through the mass to cause it to disintegrate. —C. G. Williams.

Overloaded

A system was recently installed by the writers in taking care of multiple-machine assignments, which for simplicity is termed "variable head assignment plan" might be of interest. This plan retains the piecerate system but otherwise follows the method outlined in the narrative, in that it pays the operators on the basis of actual work performed in loading and otherwise attending to the needs of maintaining machines in operation.

Before the institution of the plant, piece rates on multiple operations were established on the basis that an average operator is able to attend a given number of machines. This system proved too inflexible as it prevented better-than-average operators from attending additional machines without misapplication of rates and caused below-the-average operators to fall down in output per machine with consequent machine-load losses. It was the common practice under this condition to have experienced operators idle 30 minutes in every hour while beginners were failing to maintain the specified number of machines.

This condition led to the institution of the "variable head assignment plan" on multiple-machine operations. Briefly, this plan is to set piece rates, specifying the maximum and minimum number of heads to be attended by an operator and the expected hourly output per machine. An operator is permitted to attend as many heads within the specified range as his efficiency will permit, maintaining the expected output per head per hour.

The control of the plan is simple, since the piece rates are constant and machine efficiencies are reflected in earnings. For example, assume a new

operator on a job which the maximum and minimum number of machines are ten and five respectively. The operator will be assigned five heads until he earns his guaranteed basic rate at which time he will be permitted to attend six machines until he earns the next expected rate per hour and so on until he becomes expert and can operate the maximum number of ten machines and earn the predetermined maximum rate per hour.

—J. Kollarik and E. H. MacNiece,
Industrial Engineers

When the number of machines in a gang is sufficient to eliminate all man-waiting time, then the logical basis of payment is the time required to unload and load. Under such conditions the cutting time required by the machine does not enter as a factor in setting the price, no matter how long it may take to machine one piece in comparison with another. When the operator is paid for handling and is kept fully employed, he has obviously nothing to lose from a long machine cutting time.

It would be a mistake, however, to pay the same price for all pieces, even though the production from each machine did happen to be the same. The price should correspond to the actual time needed to handle the particular part, otherwise the operator's earnings will not be at all uniform. For instance, the handling time on some jobs is twice as long as for others, hence, if several such jobs were included in the combination being worked on, the total pieces produced would be less and the operator's earnings consequently lower. The reverse of this would take place when a number of short-handling-time jobs came together. To arrive at a fair price the appropriate allowances for total upkeep, truck moving and gaging must be added as part of the handling time of the job. —John Alexander,
Hamilton, Ont., Canada

Poetry of Motion

Time and motion study have their place in industry, but they should be only a means to an end and not be made a fetish to be followed blindly. Learners in any line may well be shown the motions used by experienced operators, either personally or by motion pictures. But it is a mistake to insist on their following these motions if they can perform the operations with equal or better results in any other way. One successful method is to say to a new man: "Here are the tools we use. We find this is a good way to use them, but if you can give us equal quality and equal or better time by other means, go to it."

I agree with E. H. Fish that if the awkward man gets better results it is a mistake to try and train him to your particular method, no matter how graceful it may seem. —Frank C. Hudson.

How Much Economics?

Having been called upon a number of times to act as intermediary in cases of labor trouble, I am impressed with two facts, namely:

The lack of real information that the average employee possesses with reference to items other than his own wages that enter into the final costs of a product.

The general willingness to accept a clear, frank explanation of such cost components and the necessity for each, when such explanation is put forward without any attempt to mitigate the importance of the employee's share in the total.

It is natural that in any large organization, each succeeding step in grade as regards authority, from the general manager down to the humblest worker, has available less information as to operating data of the business.

This being the case, I am a firm believer in frank explanations of as much of the principles of plant economics as possible being extended throughout an entire organization.

The average man wants to be fair,

but being also wholly human, he is naturally inclined, without proper steering, to reason things out along wholly selfish lines. To merely deplore this tendency and accept it as inevitable is weak, and entirely unjustified by good "human engineering."

—D. C. Wright,
Works Manager,
Graver Tank & Manufacturing Corp.

Old Man Opportunity

Most men would not appreciate the opportunity offered to better themselves. They would feel that it was a scheme of the boss to get work from them at no expense to the company. The few, who would be interested, would probably be deterred from accepting the offer by the comments of the rest.

There is no question as to the wisdom of adopting such a betterment program, but a question does arise as to the method of operating the plan. It must be worked so that no suspicion enters the workingman's mind that it is being used as a means of getting work done at nc cost. Also, some advancement, no matter how slight, must be the reward for the effort.

In a case I know of, an office boy was broken in as a tracer in the drafting room and worked so hard and willingly in the three weeks' probation period that the plan has been used ever since But discrimination in accepting students must be employed.

—Bernard Shereff,
Engineer, American Hard Rubber Company

No Questions Asked

On his own showing Longman is no diesel expert, so his criticisms may be ill founded. The president has covered the company against financial loss by limiting responsibility to that of providing sound materials and workmanship. Under such circumstances its reputation is in no danger even if the invention fails in actual practice. A man with a successful record of previous inventions, willing to back his new design with $35,000 is likely to have sound technical data back of this design and good reasons for expecting at least some measure of success.

One of the greatest obstructions met with in developing really novel inventions, as distinct from mere improvements to existing practice, is the attitude of men who know that they simply won't work, and are ready, even at personal loss to themselves, to condemn them without practical trial. It is commonplace knowledge that but for the vision of men who have been willing to spend good money on experimental work, many of the greatest inventions of recent years would not yet be in service.

—C. Norman Fletcher,
Managing Director,
Edward G. Herbert, Ltd.,
Manchester, England

Functionalizing

Routine items can be kept from becoming vital by making each departmental foreman turn in a daily report on the status of all jobs within his department to his immediate superior.

The assistant general foreman should receive these reports daily and check the jobs with the production schedule as set up by the planning department. Any items falling behind schedule, or doubtful items, should be turned over to the general foreman who will whip them back into line

Extremely important jobs coming into the shop should be checked by the general foreman and if there is the least doubt as to getting the job out on time the production manager should be notified so he can make the proper arrangements to get it through without delay for material or interference from other jobs.

—S. R. Tobias

Stockholder vs. Employee

As president of the Mid-City Machine Works, I would present a report along the following lines:

Stockholders now receive only half of their former income, and I do not think it would be good business to cut the dividend rate further. Employees have been reduced to a minimum consistent with the retaining of our working organization intact. Machine efficiency has been increased, and we have acquired higher production. We are now geared too high. In short, we must lay off a large percentage of our employees or adopt a six-hour day.

I am in favor of the latter course for several reasons:

1. The plan takes care of our employees to a far greater extent than would casting a considerable number adrift—men we have trained, used to our methods, and whom we may need again at any time.

2. The plan provides flexibility both as to hours and possibilities for the future. I prefer this to a four-day week. Too long a period of rest between working periods may be harmful.

3. If matters should become worse, we could in an emergency resort to the six-hour day, five days per week, and still maintain our organization.

—Bryan T. Hawley.

Turning Backward

To scrap our labor saving machinery is impossible. All the benefits that go with the present age are a direct result of mass production by the aid of the machine. To make these products with hand labor would cost so much that sales would be almost non-existent.

To say that we are suffering from overproduction is not true as long as people need food, wear old clothes, or drive obsolete cars. The problem resolves itself therefore to an adjustment of the medium of exchange, so that the transfer of products from the producer to the consumer can go on continuously. To do this, money must be kept circulating. The ultimate salvation is mass production, small unit profits and high wages.

At present, we need something to start the circulation of money again, perhaps a national loan. The money gained should produce something of use to everyone, and so make a job for everyone.

—F. C. Twist,
Toronto, Canada.

Self-Contained

If every small shop had a department for washing overalls and towels for its men, the washing would cost more than was justifiable. Yet I know some large manufacturers have a laundry within their premises. The same would be true if every small manufacturer employed men or women to prepare food for the force. But if the large plant did not have its lunchroom, much needless effort would be exercised by employees having to walk long distances to get their meals.

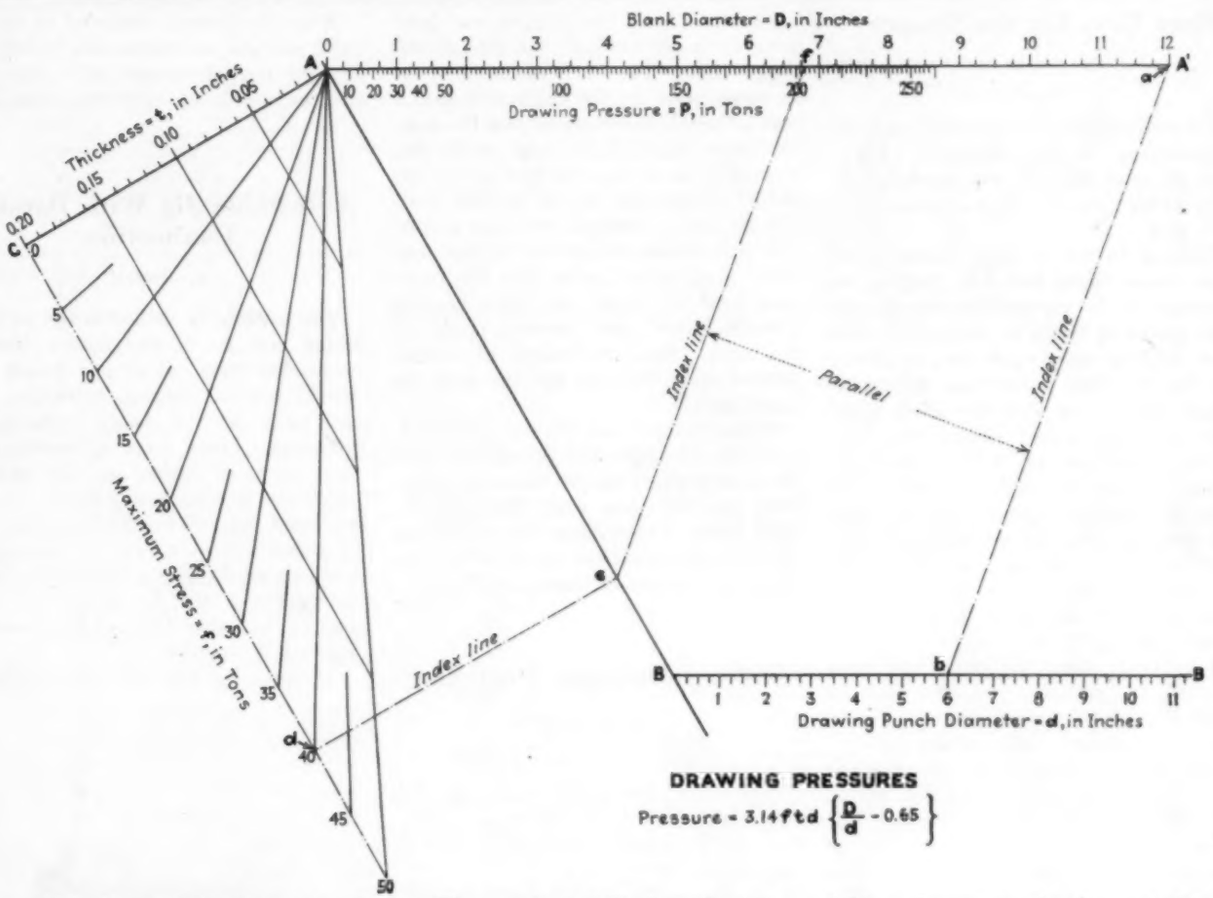
In manufacturing a mixed product or specialized products on a small scale, where overhead expenses are as high as the manufacturing cost, it would be a foolish policy to engage outsiders to do the job, because the small man lives on the overhead which includes his bread and butter. If lots of 100 pieces or more is the basis for manufacturing, specialized processes in some other plant may be taken advantage of. I know, for instance, a shop where several sizes of semi-diesel engines are made. The smaller types are made in lots of 100, whereas the larger models are put through in batches of 25 or less. When making piston pins for the smallest engines, they are sent to another factory to be ground on a centerless grinder, which constitutes a 50 per cent saving.

When making jigs and fixtures, the small manufacturer should consider the boring of necessary holes at another plant, having a jig borer.

—A. E. Fristedt,
Bolinder Works, Stockholm, Sweden

American Machinist
Reference Book Sheet

Graphical Estimation of Drawing Pressures


Blank Diameter = D, in Inches
Drawing Pressure = P, in Tons
Thickness = t, in Inches
Maximum Stress = f, in Tons
Index line
Parallel
Index line
Drawing Punch Diameter = d, in Inches
DRAWING PRESSURES
Pressure = 3.14 f t d {D/d - 0.65}

Although it is difficult to state with precision the pressure required to draw a shell, nevertheless from the data furnished by Caserta and Blake and corroborated by E. W. Bliss Co., an approximate formula has been evolved, reading as follows:

$$P = \pi ftd \times \left(\frac{D}{d} - 0.65 \right) \quad (1)$$

which may be further simplified by the removal of the brackets and the transposing of certain of the terms:

$$\frac{P}{\pi ft} = D - 0.65\ d$$

P=Drawing pressure required in tons
f=Maximum stress in the stock in tons per sq.in.
t=Thickness of the stock in inches.
D=Diameter of the blank in inches.
d=Diameter of the drawing punch in inches.

The constant 0.65 depends somewhat on die conditions, material, shape and machine, and may vary from 0.60 to 0.70. Irregular shapes cannot be estimated by this method.

Referring to the figure illustrated, the nomograph will be seen to comprise two horizontal parallel axes lettered AA', BB', a diagonal member AB, an inclined axis AC and a group of radials.

The axis AA' carries scales on its upper and lower edges reading the pressures respectively. BB' is graduated in terms of the drawing punch diameters. The thickness of the stock is shown on AC, and to the radial lines, values are assigned for the maximum stress in the stock. Each radial line is so positioned that a vertical drawn from any point on AC to intersect it, when extended at right angles, meets the diagonal AB at a point denoting the product πft.

To use the chart, join any value of D and d, determine the product πft by the construction previously explained, and from the corresponding point on AB, draw a second index line, parallel to the first one, which indicates on the scale of P the drawing pressure.

The example depicted on the figure is chosen at random and represents a reduction of 50 per cent which is somewhat in excess of that recommended when consistent results are desired using material of 0.2 inches in thickness.

In practice the percentage reduction is influenced by the thickness and quality of the stock. The reduction applies to first operation drawing tools only.

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Contributed by A. Allison, London, England

• IDEAS FROM PRACTICAL MEN

More Uses for the Shaper

F. C. TWIST
Toronto, Canada

On reading Stanley Pivowski's article, "Assembling in the Shaper" (*AM*—Vol. 76, page 311), I was reminded of some other uses to which a shaper has been put.

Having to cut a large quantity of ¼-in. brass tubing into 2-in. lengths, we arranged to do the work in the shaper. Two pieces of ½x¾-in. cold-rolled steel were held in the shaper vise, as shown in Fig. 1. One piece was drilled to admit the tubing and the other acted as a stop. A Dumore grinder fitted with a high-speed saw was held in the toolpost. The shaper table was moved so that the distance between the stop and the saw was 2 in. In operation, the tubing was pushed through the hole in one of the cold-rolled pieces and contacted with the one acting as a stop. The speed and the stroke of the shaper were set so that, after one piece had been cut off, the operator just had time to push the tubing against the stop before the next forward stroke of the ram.

Another job was redrawing a small quantity of thin cups to ⅞ in. in diameter and 1⅛ in. in length. The cups were first drawn to 1⅛ in. in diameter in the usual press tools, but the stroke of the press was too short for the redrawing operation. Since the quantity required was not large and since we had a heavy shaper, we decided to do the work on it, rigging it up as shown in Fig. 2. The punch was held in a holder that was placed in the hole in the clapper usually occupied by the toolpost, and the clapper was held down by a pin through the side of the clapper box. The die was mounted on an angle plate on the table and had a hole to permit the work to pass through. To locate the work in front of the die, a small V-block was blocked up to the correct height and in the correct position to hold it central with the punch. The speed and the stroke of the machine were set so as to give the operator time to place the work in the V-block before each forward stroke of the ram. The cups were, of course, pushed clear through the die and the angle plate.

While this method worked quite well, it is now recommended for any but light stock on a heavy shaper, although somewhat heavier jobs could probably be done safely if the top of the angle plate were connected to the body of the machine by tierods of some sort.

Making Machines Portable

L. G. PATTERSON
Factory Superintendent, Armstrong Machine Works

On reading the article under the title given above by L. B. Murdock (*AM*—Vol. 76, page 245), it called to mind an experience of my own.

Having use for a portable sensitive drill press, I rigged up one of our motor-driven drills as shown. The steel skids *A* are attached to the under side of the base by bolts and have eyes at the rear ends in which the lever *B* is pivoted. The skate rollers *C* are attached to the lever in such a way that, when the lever is moved to the rear, the rollers are brought into contact with the floor. Further movement of the lever in the same direction raises the rear of the machine from the floor, the rollers acting as a fulcrum. The machine can then be moved to any desired place, the rear rolling on the rollers and the front sliding on the skids.

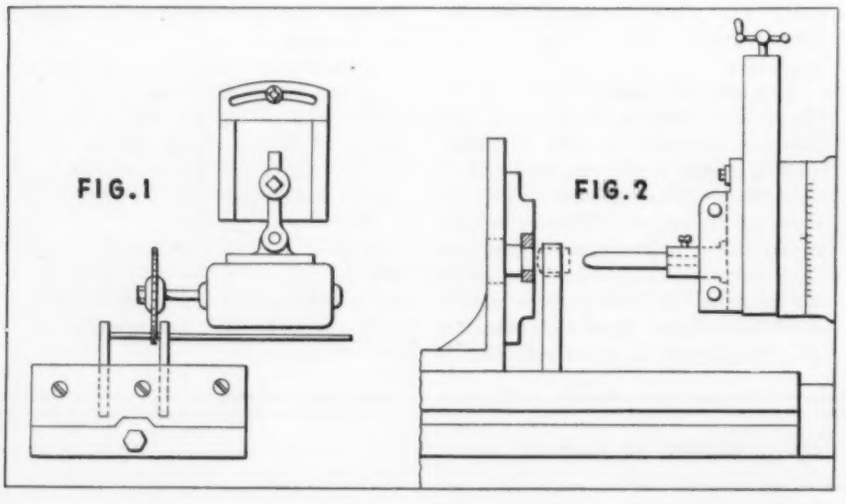
When the lever is returned to its upright position, as shown, the rollers are brought out of contact with the floor and the machine rests firmly on its base.

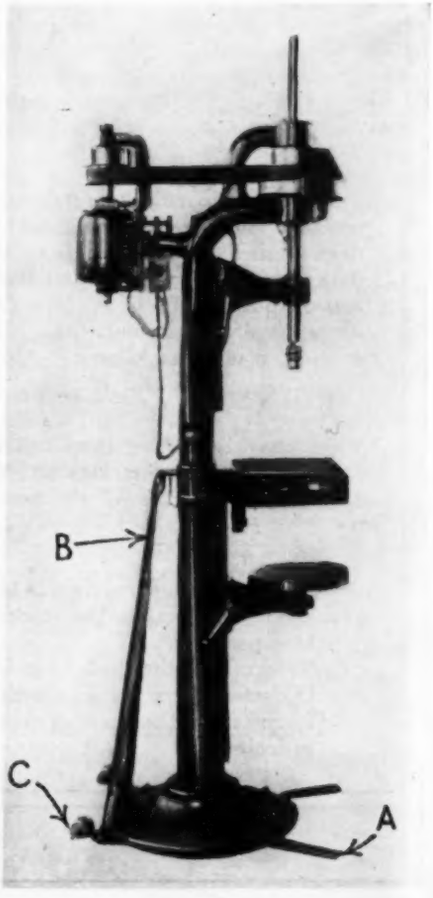
Adjustable Jig With Parallel Connection

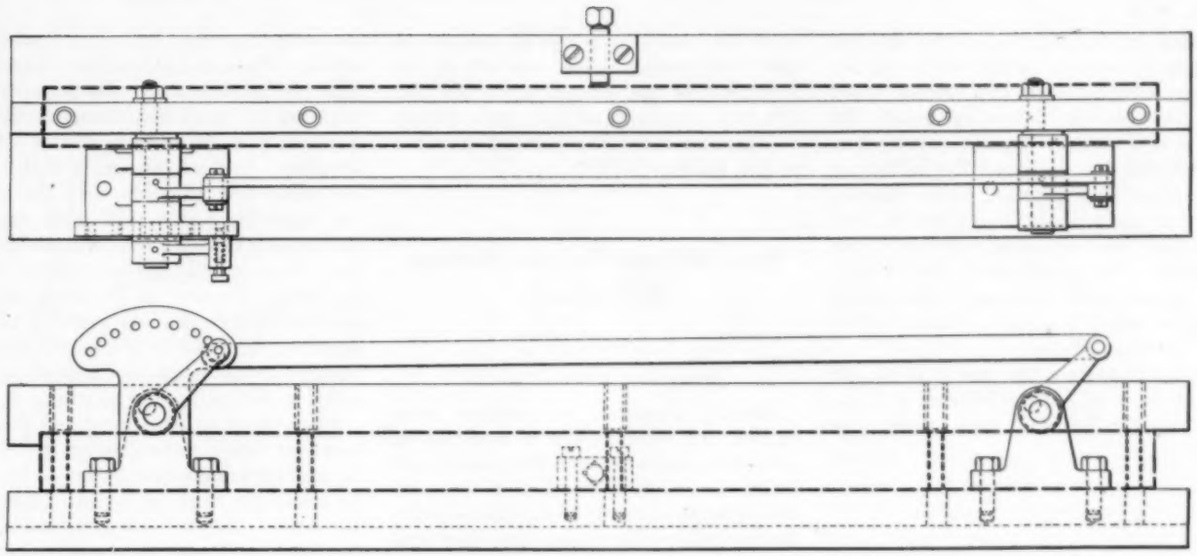
F. SERVER

The work to be drilled in the jig illustrated consists of rectangular bars of cold-rolled steel, all of one length and width, but of varying thickness. At the ends of the base brackets are mounted. These serve as bearings for two eccentric shafts, on the ends of which the bushing bar is fitted. On the left-hand end of the bushing bar is a lip which acts as a stop for locating the work endwise. The adjustable screw at the center of the jig presses the work against the inner faces of the brackets, locating it sidewise.

Mounted on the eccentric shafts are







levers connected by the top bar, which rotates the eccentric shafts in unison. On the outer end of the left-hand eccentric shaft is an index crank, the pin of which engages an index plate that is an integral part of the bracket. Moving the index crank imparts motion to the eccentric shafts through the bar and the levers, raising or lowering the bushing bar. The index plate and pin serve to locate the height of the bushing bar above the base and to lock it in position. Thus the adjustment of the bushing bar for height permits work of different thicknesses to pass under it.

Because of the action of the eccentric shafts, the bushing bar is moved endwise as well as up or down, but since the work is located against the lip at the end of the bar, its location in reference to the bushing bar and its bushings is not disturbed. The clearance holes for the drills in the base are elongated to compensate for the endwise movement of the bushing bar and its bushings.

The advantage of having a jig equipped with the adjustable features described will be apparent when it is considered that in any one batch of bars to be drilled there are bars of different thicknesses, and that it is easier to adjust the jig than it would be to sort out the different thicknesses and keep them separate.

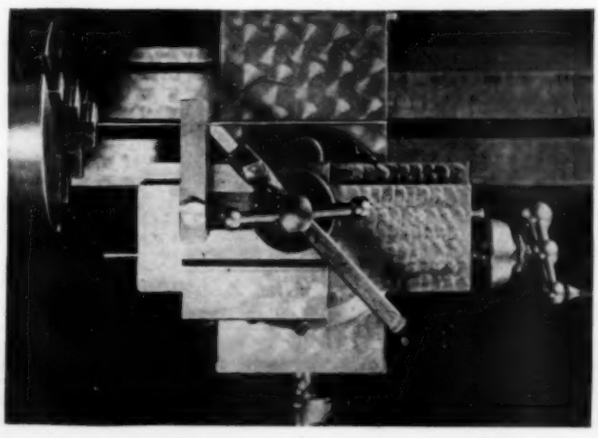
Turning Slender Work
Discussion

MALCOLM K. PARKHURST

In an article under the title given above (*AM*—Vol. 76, page 279), F. E. Fick describes a method of turning slender work in the lathe. While the device used apparently met Mr. Fick's requirements, I would like to point out an equally simple but more effective means for accomplishing the same end. The set-up is shown in the illustration, in which the work is being turned to 0.032 in. in diameter.

The device is a "lead" rest of a simple and accurate type. The guide block forming the rest has in it a hole in which the stock being turned is a running fit. It is not necessary that this hole be precisely in alignment with the lathe centers, in so much as the long, slender rod has sufficient spring between the rest and the chuck to act as a sort of flexible coupling.

As regards the particular advantage of this method, it will readily be seen that almost any desired length of cut can be made in a single advance of the tool, as compared with the successive cuts necessary in Mr. Fick's method. Furthermore, the rod being supported directly at point of the cutting tool permits of high accuracy in the finished diameter, regardless of how slender or how long the work may be.



A Self-Balancing Chuck
Discussion

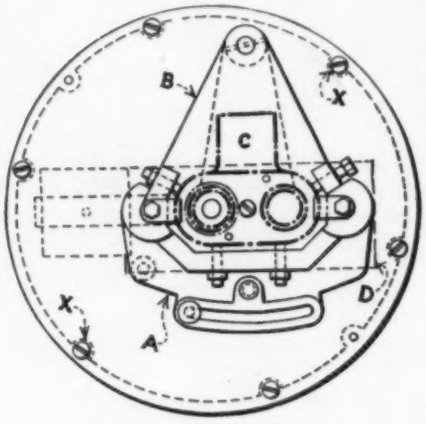
DONALD RAEBURN
Glasgow, Scotland

In an article under the title given above (*AM*—Vol. 75, page 967), James L. Ingalls describes a chuck for automatically balancing work to be machined. In the course of his article, Mr. Ingalls states that by the use of this simple device a good working balance is secured. What does a good working balance mean? If the work is counterbalanced by an opposed weight and there is no apparent vibration, must we accept this as a working balance?

In machining off-center work, such as is shown in Mr. Ingalls' chuck, it is rotating balance that is required, and that can be obtained only by the correct

location or distribution of the balance weights in relation to the work and the fixture, coupled with the correct speed and an available indicating point. In the sketch of Mr. Ingall's chuck, here reproduced, the work and the holder are partitioned off by dotted lines. Assuming that the scale is 1½ in. per ft., two triangles, two rectangles and one square comprise the work and the holder, for which the necessary calculations must be made to obtain correct rotating and working balance.

In the triangle *A* the base is 11 in., the height is 3 in., the thickness is 1 in., making the volume 16½ cu.in., the



weight being 4.29 lb. The second triangle *B* is 8x6½x1 in., or 26 cu.in., the weight being 6.76 lb. Likewise the weight of the square *C* is 4.06 lb., approximately. Since the weights of *A* and *C* closely approximate each other, for all practical purposes they may be considered as being in balance. But *B* remains unbalanced.

If the counterweight, which swings with the movement of the work and the fixture, balances the rectangle *D*, then Mr. Ingalls' statement that the weighted arm must lie in the same plane as a line drawn through the center of the hole to be bored is not wholly correct. The weighted arm should lie in the same plane as a line drawn through the center of the hole to be bored, but in correct relation to the out-of-balance parts of the work and the fixture. This position would be close to the points *X* in the sketch.

For work held in a fixture, a locating index for rotating balance can be obtained on the first piece of work by machining the face and scribing a fine circle upon it, the circle to be in correct relation to the centers of the holes to be bored. To make a test for balance, disengage the cone from the spindle and revolve the chuck by hand. Then engage the cone and the spindle and revolve the chuck by power at the correct speed for boring. The amount of eccentricity of the scribed circle will decide the accuracy of the work fixture and the necessary positional adjustments of the balance weights.

Special Jaws for the Boring Mill Chuck

L. G. PATTERSON
Factory Superintendent, Armstrong Machine Works

Having occasion to machine some rather long work in the vertical boring mill, the auxiliary jaws illustrated were made of machine steel and were attached to the jaws of the machine chuck. Each auxiliary jaw was equipped with two hardened steel pads, bored to suit the work and checked for grip. The lower pads are firmly attached, while the upper ones are pivoted on pins to accommodate themselves to any inequalities of the work. Pads can be made for holding tapered work, or work of various shapes.

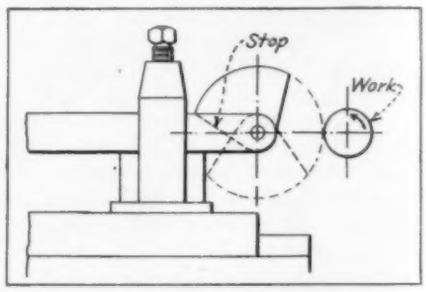
Rolling Letters Into Work

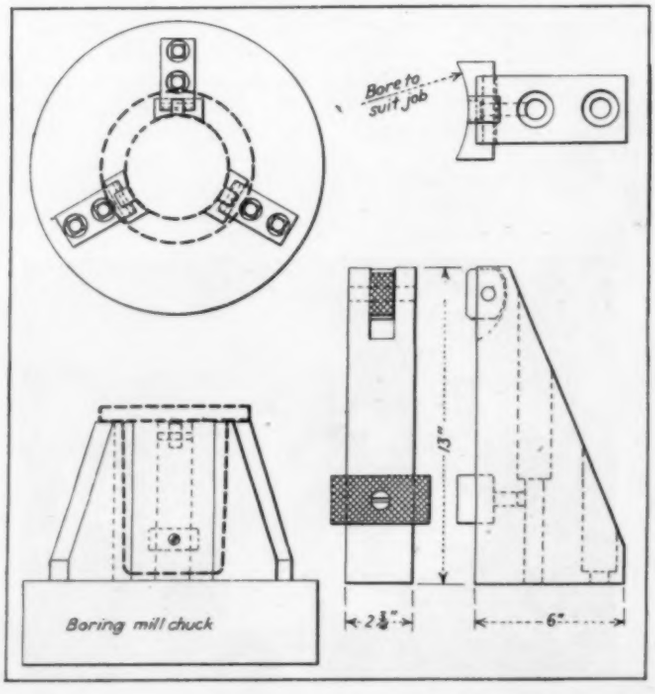
ERNEST C. ALLEN

In rolling into work in a lathe or a screw machine, the usual practice is to gear the roller containing the letters to the work spindle and to feed in the roller radially. This method is not altogether satisfactory for several reasons, one being that the roller remains in contact with the work during several revolutions. When the letters have been fully imbedded in the work, the ratio of the roller to the work has changed slightly, resulting in a blurred appearance of the lettering. Another reason is that when the roller first contacts with the work, the gears are not in full mesh and do not come into full mesh until the letters have been imbedded their full depth in the work. Because of the angles of the gear teeth, the gradual meshing of the gears as the roller is fed in changes the relative position of the letters on the roller to the letters in the work.

In the illustration is shown an arrangement in which the roller, or rather the sector, containing the letters is in contact with the work for a part of a revolution only. The sector is mounted on the toolblock and rests by gravity against a stop and out of contact with the work, as indicated by the full lines. The toolblock abuts a stop that will bring the letters to the full depth when the sector is brought into contact with the work.

When ready to roll the letters into the work, the sector is tipped forward against the work, the rotation of which carries



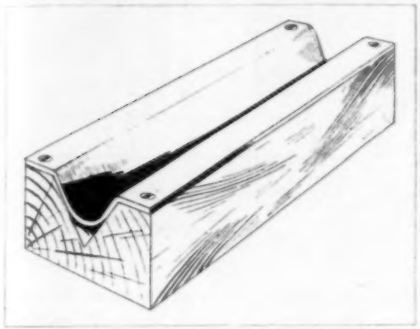


it through the rolling process. After the letters have been rolled in the work, the sector comes to rest in the position indicated by the dotted lines. It must be reset before being used again.

Holding Polished Pipe in the Vise—*Discussion*

ROBERT S. ALEXANDER
Universal Winding Company

While the method outlined by D. W. Patton in an article under the title given above (*AM*—Vol. 76, page 515) has its merits, I believe the work can be handled by simpler means. In holding highly-polished round work in the vise,



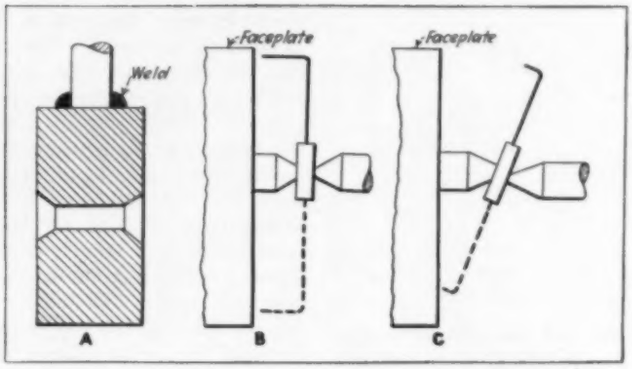
I use a pair of wooden V-blocks similar to the one illustrated herewith. On the working surface of each block is securely fastened a piece of ⅛-in. leather having sufficient area comfortably to fill the V when the work is in position. The leather is a protection against marring the work and is almost wearproof. It can be cleaned by the moderate application of gasoline, of course, with proper precautions in the open air.

Device for Aligning Lathe Centers—*Discussion*

P. OPPUYSEN
Guadalajara, Jalisco, Mexico

Referring to the article by Mark L. Gluckman under the title given above (*AM*—Vol. 76, page 308), it will be almost impossible to align the centers within 0.001 in. with the device there illustrated, because screwing up the tailstick center tightly will bind the steel plates and prevent them from sliding easily. Also, the difference of 0.001 in. between the lines scribed on the plates can be detected only by a microscope.

I have used for the same purpose a piece of ½-in. round steel rod ¼ in. long and centered at the ends, as shown at *A* in the illustration. On one side of the steel piece was welded a piece of



wire having the outer end bent at a right angle. Holding the device between centers and rotating it by hand, the bent end of the wire will be equidistant from the faceplate at all points when the centers are in line, as at *B*. If the centers are not in line, the space between the faceplate and the bent end of the wire will vary as the device is revolved, as at *C*. Since the length of the wire is much greater than the misalignment of the centers, any error will be greatly magnified.

A Powerful Straightening Device

J. T. TOWLSON
London, England

This straightening device played an important part in the production of hubs for the landing wheels of airplanes during the World War. In the rush of wartime supply, tons of bars of chrome-vanadium and other alloy steel, from which the hubs were to be made, were delivered far from straight. Since the bars, in 10-ft. lengths, were to be ground to a diameter of but $\frac{3}{32}$ in. less than their rough diameter, they had to be straightened.

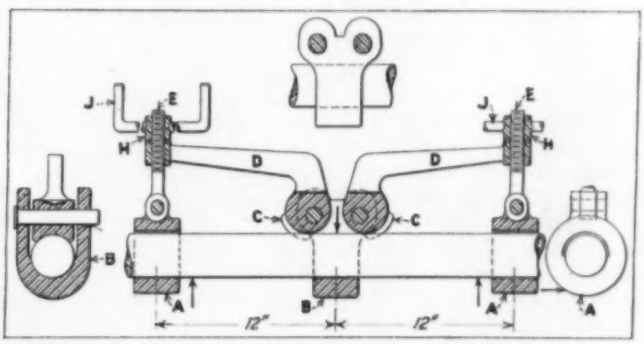
The device is shown mounted on one of the 4-in. bars. At *A* are collars of cast steel to hold the bar. At *B* is U-shaped yoke of cold-rolled steel, upon the legs of which the cams *C* are fulcrumed. Extending from the cams are the levers *D*, ending in collars surrounding the screws *E*, which are pivoted at their lower ends.

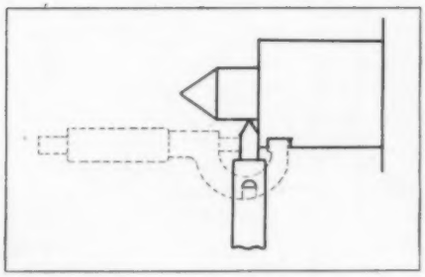
In operation, the device is slid along the bar until the cams are over the part to be straightened. Then the nuts *H*, turned by the levers *J*, are screwed down, carrying the outer ends of the levers down and bringing the cams tightly into contact with the bar. Further screwing down of the nuts results in bending the bar in the desired direction to take out the kink. When the nuts are unscrewed, the outer ends of the cam levers are raised by springs under their collars. The power ratio of the levers and the cams is in the neighborhood of 12 to 1, thus multiplying the usual bending effect.

Cutting Multiple Threads

W. H. MOORE
Hamilton, Ontario, Canada

While there are several methods in use for indexing for multiple threads, I recently came across one that was new to me. The tailstock spindle of the lathe had a vertical slot cut on the operator's side near the front end. After cutting the first thread, the work was removed from the centers, and the end of the tailstock spindle was brought into contact with the side of the threading tool. The distance from the slot to the





far side of the tool was measured by a micrometer, as indicated in the sketch, the anvil of the micrometer being placed in the slot.

Then the pitch of the thread being cut was added to the distance just measured and the micrometer was set to the total. Next, the tool was moved by the compound rest to the position of the next thread, being checked by the micrometer, which was used as before. The work was then put back on the centers, and the second thread was cut. This operation was repeated for each of the remaining threads. At no time were the lead screw and its nut nor the pick-off gears disengaged.

An Unusual Facing Head

OTTO R. WINTER

We had a lot of steel castings to be bored and faced, the work to be done in a horizontal boring mill. The boring was done in the usual way, but as it was necessary to cut into one corner of the work in facing, the ordinary single-point facing tool was considered to be too slow and not adapted for heavy cutting. So we made the facing head illustrated.

The cutting tools are held in six holders, mounted in grooves in the head, the tools being staggered in the holders to break up the chips. They are ground on a surface grinder while in the holders, so that all will cut to the same depth.

In use, the facing head is keyed to the boring bar far enough back of the boring cutter not to interfere with its operation. After the hole has been bored in one piece of work, the boring cutter is removed from the bar, and a split bushing fitting the bar is placed in the hole just bored. Piloted in this bushing to stiffen it, the bar is fed forward, bringing the facing cutters into contact with the work. While the resulting finish is not dead smooth, it is accurate enough to permit another part to be bolted to it in correct alignment.

Drawing in a Single-Action Press

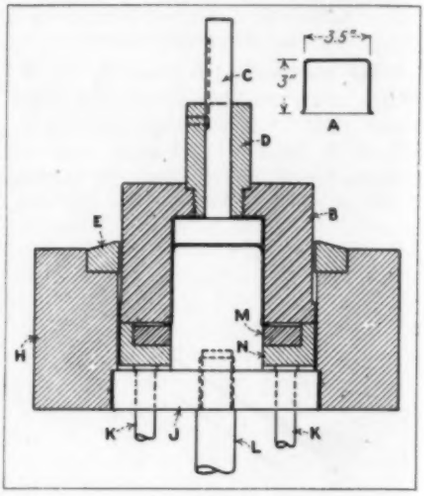
JAMES R. CORNELIUS

Coventry, Warwickshire, England

The market is overstrewn with ideas that proclaim their adaptability for performing deep-drawing operations in a single-action press. While not discussing their respective merits, I do want to show how simple such operations may be made by a little thought and consideration.

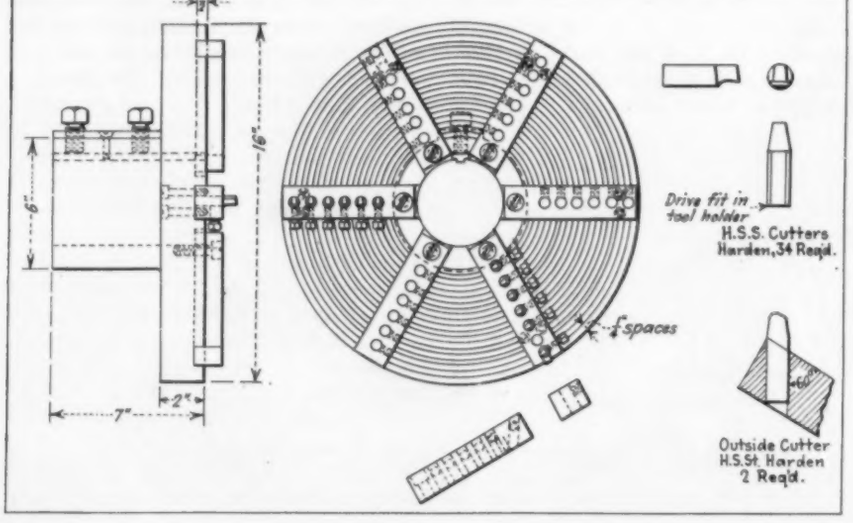
The cup shown at *A* in the illustration was to be drawn from stock 0.032 in. thick. To do this work at the price offered in these cut-throat times would permit of only one operation and with one set of tools if any profit was to be made. The double-action presses were fully occupied on other work, but we had one long-stroke single-action press that would accommodate the job. To attempt to draw to the depth of 3 in. at one stroke with no special pressure absorber would be disastrous, for at 2 in. the bottom would be pushed out of the blank. However, the trick was done with the tools described.

A set of tools was made as shown. *B* is the punch, *C* the auxiliary pad, *D* the stem, *E* the cutting ring, *H* the bolster, *J* the center block, *K* the pressure pins, and *L* the buffer stick with the usual buffer plates and springs bearing beneath the pins *K*. The pressure



ring was made in two parts, as at *M* and *N*. The ring *M* was a push fit in the ring *N* with a difference in height at the top face equal to the thickness of the stock plus 0.002 in., the higher face being 0.3 in. wide at the outer edge.

In operation, the punch and the cutting ring sheared the stock, which was held between the punch face and the ring *N* through pressure on the pins *K* from the buffer. As the cup was drawn over the center block, the blank approached the inner edge of the ring *N*. A slight radius here permitted the blank to slip as it reached the edge and the punch face came into contact with the ring *N*. Further pressure on the blank was then impossible and it slid between the punch face and the ring *M*, the close tolerance preventing the formation of wrinkles as well as relieving all the stretch common with combination tools. It will be seen that once the inner edge of ring *N* was reached, the tools operated exactly as would double-action tools.

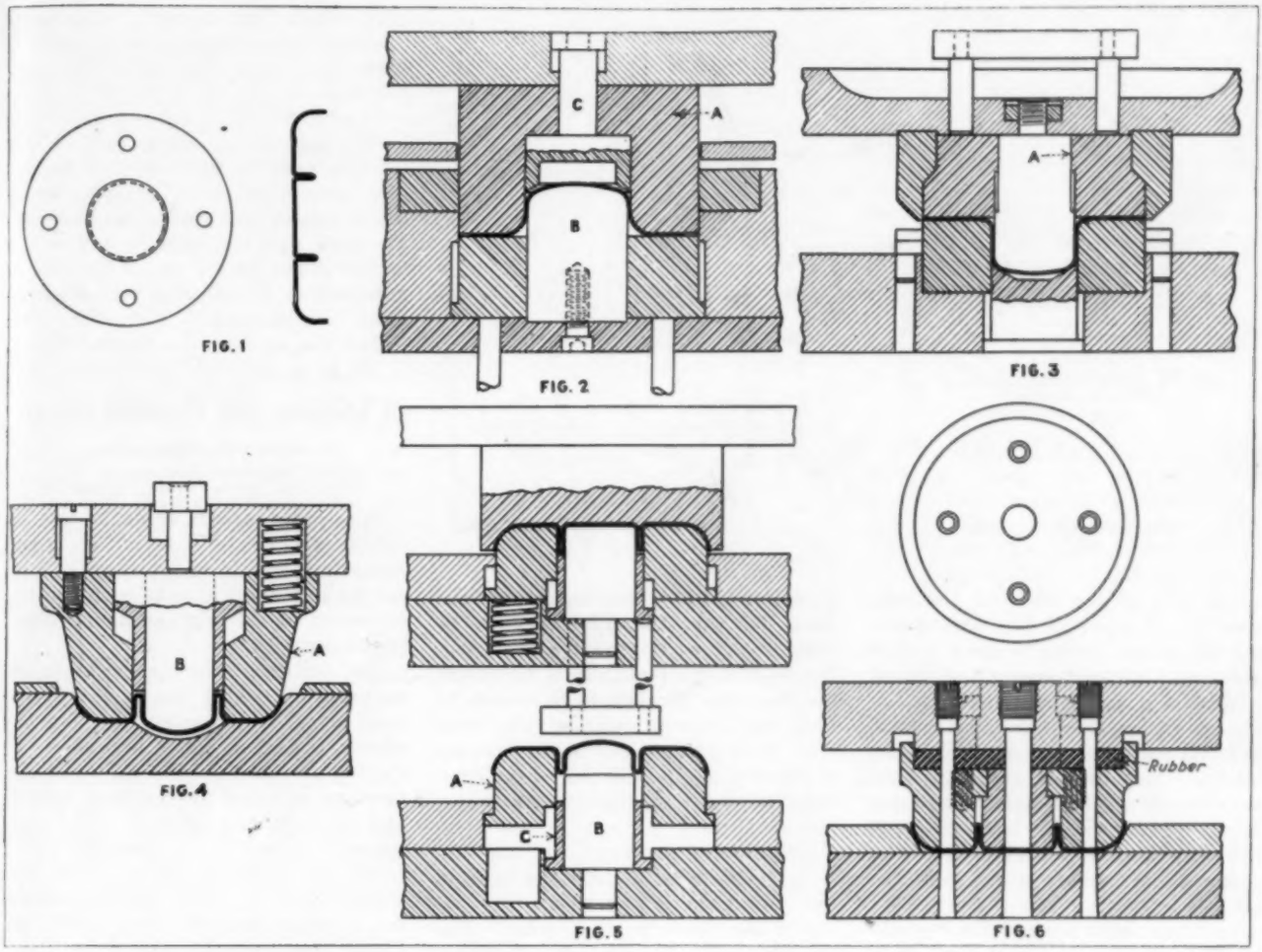


Press Tools for End Bells of Motors

WM. C. BETZ

Master Mechanic,
The Fafnir Bearing Company

Stamped sheet-metal bells for the ends of small motors, one of which is shown in Fig. 1, are very much lighter and can be produced at about one-fourth the



cost of the cast-iron bells formerly used.

In the production of stamped bells, the first operation is a combined one of blanking and forming and is done in a single-action press by the tools shown in Fig. 2 at the rate of 2,500 per hr. The blank is cut out and first formed by the combination blanking and forming punch *A*, the fit between the punch and the horn *B* being free enough so that no ironing takes place to harden the metal. As the punch ascends it carries the blank with it and as the ram nears the top of its stroke, the positive shedder *C* knocks the shell out of the punch and, as it falls, a blast of air blows it clear of the tools. The air valve is operated by a cam on the free end of the crankshaft.

Finish forming the cup and flattening the rim is done by the tools illustrated in Fig. 3. To locate the cup, the shedder *A* has a very light spring (not shown) behind it and, on the down stroke, it contacts with the rim of the cup so as to hold the blank at a right angle to the travel of the punch, insuring that the forming punch will strike the cup centrally and form it correctly. As the punch ascends, the blank is carried up with it being shed by the action of the shedder *B*, and then blown off by a blast of air.

In the next operation, the flange is turned up by the punch *A* in Fig. 4, which is backed by heavy springs, and the cup is turned inside out by the punch *B*. As the ram ascends, the blank is shed and blown off as before. Ironing out the cup to size it for the ball bearing; closing the housing flange, metal tight; and finishing the ironing out of the outer flange is done in the tools shown in Fig. 5. Referring to the illustration, the part *A* projects above the punch *B* by the action of springs and the resting of the punch upon the die-shoe. The blank is placed on part *A* and as the ram descends it carries the blank and the part *A* down and irons out the inside of the cup on part *B*, closing the metal tightly between parts *A* and *B*. As the ram ascends, the blank is carried up to the limit of travel of part *A*. At this point the part *C*, which is actuated by a cam knockout in the die, pushes the finished blank clear of the tools and it is brushed into a chute.

In the last three operations, the blanks are hand fed at the rate of approximately 900 per hr., but this quantity could be increased to at least 1,500 by the use of either a dial or a slide feed. In the piercing operation, the tools for which are shown in Fig. 6, one-half of the bells are pierced in the cup to allow for the armature shaft, while in the other half this hole is omitted by taking the central punch out of the punch-holder.

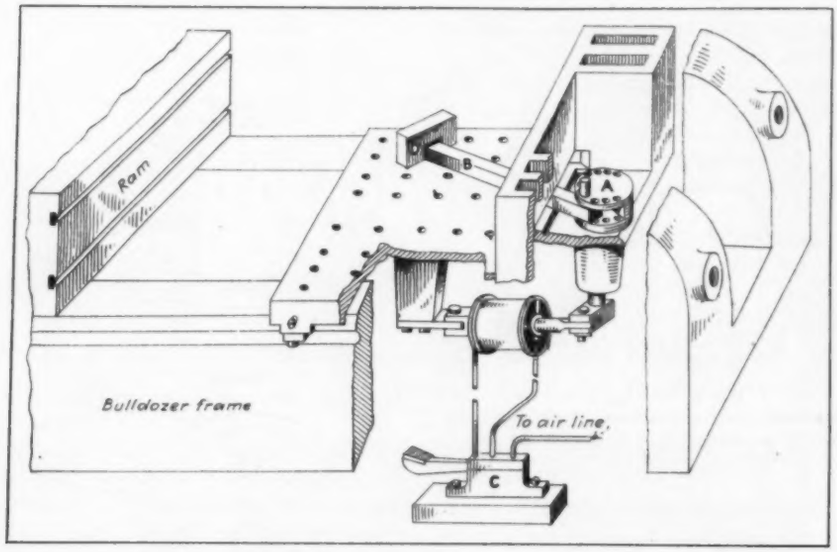
An Air Clamp Applied to a Bulldozer

L. F. LARSH

Tool Designer,
Oliver Farm Equipment Company,
Hart-Parr Division

Having experienced considerable trouble from the slipping of heavy stock during bending operations in the bulldozer because of the failure of lever clamps to grip it sufficiently, I designed and built the air clamp shown. It has never failed to hold either hot or cold stock from slipping. Furthermore, it is more quickly operated than is a hand clamp, thereby increasing production.

The main detail is a cast-iron bolster that also acts as a sub-base for the dies. It has a lug at each corner for location



and is held to the frame of the bulldozer by clamps. A lug underneath, near the center, serves to carry a piece of flat steel to which one end of the air cylinder is pivoted. The piston rod is connected to a crank keyed to a vertical shaft, on the upper end of which is the disk *A*. This disk is slotted to take one end of the draw link *B*, and has eleven equally-spaced holes stamped with numerals from *1* to *11* inclusive. A corresponding number is stamped near the hole in the rear end of each of the several draw links to show the operator the proper hole in the disk in which to connect it by the hardened pin furnished.

By simple calculation the different angles to which to set any of the draw links have been determined and a chart has been made to show which angles to use to secure the maximum clamping pressure. This chart also gives the distance from each of the eleven holes in the disk to the face of the bolster (assuming the draw link to be in the clamping position), and allowing 7 deg. additional movement to insure the work being clamped securely. Because of the nature of the bend of the work involved, it may be impracticable or impossible to have the draw link pull straight back in clamping the work. Here the chart showing maximum clamping pressure comes in handy.

Several rows of holes are drilled and tapped in the bolster for clamping the bending dies. The control valve *C* is foot-operated. Dies for making separate bends, each on different pieces of work, and at one stroke of the ram, can be used by means of two draw links thinned for the greater portion of their lengths and working from the same hole in the disk. The head *D* is slotted to receive the end of the draw link and is welded in place. As in the lever-operated clamp, the forward ends of the dies must be cut out to clear the head of the draw link and the bottoms must be slotted or cored to clear the link itself. However, a good method is to mount the dies upon parallels thick enough to keep the bottoms clear of the draw link. Two pins pressed in the bottoms of the dies, one on each side of the draw link, will hold the link to its proper course of travel.

The nose of the punch, or ram-shoe, is so designed as to strike the head of the draw link, thereby thoroughly flattening the work at that point. The clamping pressure depends, of course, upon the air pressure, the diameter of the air cylinder and the throw of the crank. In the device described the clamping pressure is approximately 8,500 lb. with an air pressure of 80 lb. per sq. in.

Reaming Holes Without Bellmouth

ERNEST FOLDVARY
Consulting Engineer, Budapest, Hungary

We had a large quantity of bushings to make, such as the one shown at *A* in the illustration. Because the bushings were to be used as bearings in a small, high-speed precision machine, the specifications were very strict and required that the holes should not be bellmouthed in the slightest degree.

To ream such holes in the turret lathe was a difficult task, as any slight inaccuracy in alignment of the turret holes with the spindle would result in the holes being bellmouthed, even though a floating reamer were used.

To obviate the difficulty, a standard chucking reamer ground to the shape shown at *B* was used after the holes had been rough reamed to within from 0.001 to 0.0015 in. of finished size. The cutting part of the reamer was at the spherical end, the part behind it having been ground to clear the holes for a length greater than that of the bushings. The work with the spherical end of the reamer at the farther end of the hole is indicated at *C*, showing the misalignment exaggerated. Naturally, the reamer was mounted in a floating holder.

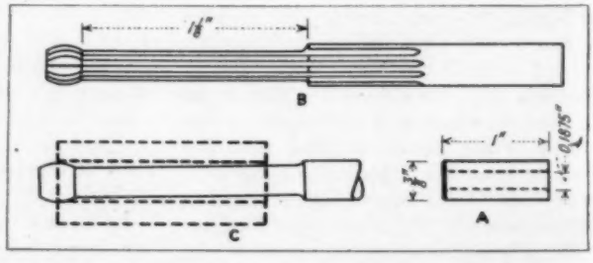
A Hopper for Feeding Shells

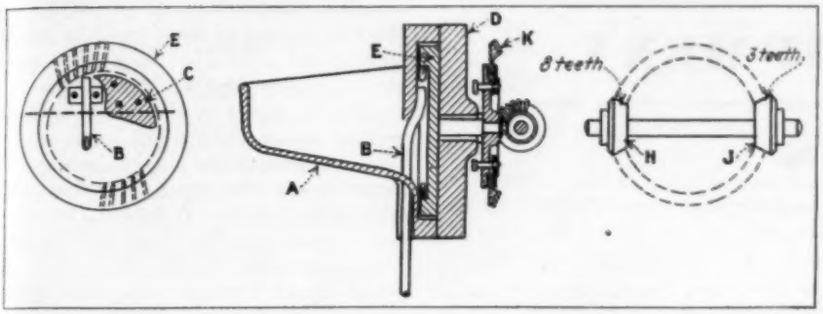
JAMES R. CORNELIUS
Machine Designer
Coventry, Warwickshire, England

Open-ended drawn shells having an outside diameter of 0.40 in., an inside diameter of 0.32 in. and a length of 1 in. are fed to redrawing tools, open end up, by means of the selecting hopper illustrated herewith.

The shells are thrown pellmell into the container *A*, which has a flat bridge piece across it and extending from the edge to the heavy dotted lines shown in the end view at the left. To the bridge piece are attached the discharge tube *B* and the retaining plate *C*. The container is bolted to the plate *D*, which carries the shaft for operating the distributor plate *E*. This plate is recessed to a depth approximately 0.030 in. deeper than the diameter of the shells to be fed. Pins are fitted askew in the periphery and protrude into the recess for about three-fourths of the length of the shells. The spacing of the pins is such that there is not room for a shell to drop between any two of them, yet two shells can lodge on two adjacent pins.

The drive is effected by means of a belt to a pulley on the shaft to which are keyed the two bevel pinions *H* and *J*. Each pinion originally contained twenty teeth, but pinion *H* has now but eight teeth and pinion *J* but three, the other teeth having been cut away to the roots. Both pinions mesh with the bevel gear *K*, which is frictionally mounted for safety in case the machine should clog. Pinion *H* drives the gear in a clockwise direction, but as soon as the teeth pass out of mesh, the gear stops





momentarily until the teeth of pinion *J* come into mesh. At this time the gear is driven in the opposite direction. These movements are repeated continuously and, owing to the difference in the numbers of teeth in the pinions, the movement of the gear is greater in one direction than in the other. Thus it will be seen that during a certain number of oscillations the gear must make a complete revolution.

Since the bevel gear and the distributor plate are keyed to opposite ends of the same shaft, the distributor plate will oscillate synchronously with the gear, causing the shells to tumble between the container and the inner face of the selector plate, passing over the pins. A fair percentage of the shells will be impaled upon the pins and will be carried around the hopper, the retaining plate *C* preventing them from being thrown off as they approach and pass the center. At each oscillation, the distributor plate stops long enough to permit a shell to drop off of one of the pins, vertically, into the discharge tube, from which it slides by gravity to the redrawing tools.

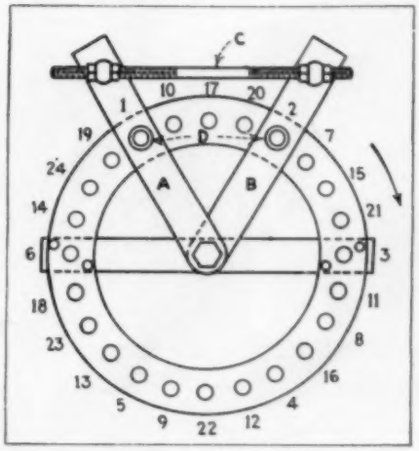
A considerable output may be obtained from such a hopper and may even be increased by duplicating the row of pins. With a single row of pins, a feeding capacity of 100 shells per min. may easily be obtained.

Spacing Holes in a Circle
Discussion

CHARLES KUGLER

Reading the article by Frank A. Gabriel under the title given above (*AM*—Vol. 76, page 406) recalled to mind a method I used in doing a similar job. There were 24 holes in the circle and the distance between the centers of opposite holes across the circle was 60 inches.

Referring to the illustration, a strut having a pivot hole in the center was attached to the opposite sides of the ring by screws and dowels. Pivoted to the strut were the arms *A* and *B*, being adjustable for angularity by the tangent



screw *C*. The bearings for the tangent screw were arranged to swivel in the arms, so that no cramping would take place in adjusting the arms. Each arm carried a slip bushing for drilling, for which a reaming bushing could be substituted. Plugs were put in the bushings and the arms were spaced for four holes, as at *D*, using an inside micrometer and measuring between the plugs.

After drilling and reaming the first hole through the bushings in arm *A*, a plug was put through the bushing and the hole *2* was drilled and reamed through the bushings in arm *B*. Holes *3*, *4*, *5* and *6* were drilled and reamed with the plug through the bushing in arm *A* in holes *2*, *3*, *4* and *5* respectively. The arms were then adjusted to space five holes. Plugging in arm *A* at hole *1*, hole *7* was drilled and reamed through the bushings in arm *B*. Holes *8*, *9* and *10* were drilled and reamed with the plug in holes *7*, *8* and *6*, respectively.

Resetting the arms to the original spacing of four holes and plugging in at hole *7*, hole *11* was drilled and reamed. Holes *12*, *13* and *14* were drilled and reamed with the plug in holes *11*, *12* and *13*, respectively. The arms were then set for the 5-hole spacing and the plug was put in hole *10* for drilling and reaming hole *15*. Holes *16* and *17* were drilled with the plug in holes *15* and *14* respectively.

Again setting the arms to the original 4-hole spacing, the plug was put in hole *9* and hole *18* was drilled and reamed. Holes *19*, *20*, *21*, *22*, *23* and *24* were drilled and reamed with the plug in holes *18*, *19*, *20*, *8*, *22* and *23*, respectively.

By this method of alternately adjusting the arms, there is not the same danger of cumulative errors that there would be if each hole were drilled consecutively with the arms set for spacing two holes.

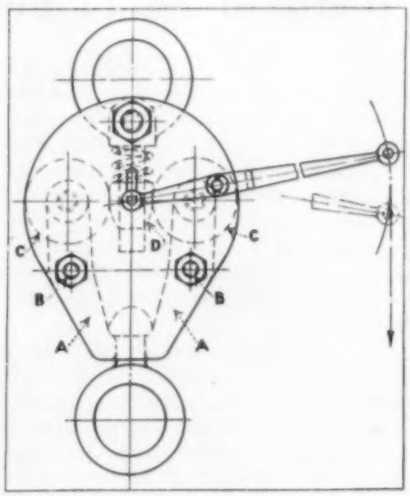
A Quick-Releasing Hook

GEORGE A. FRIES

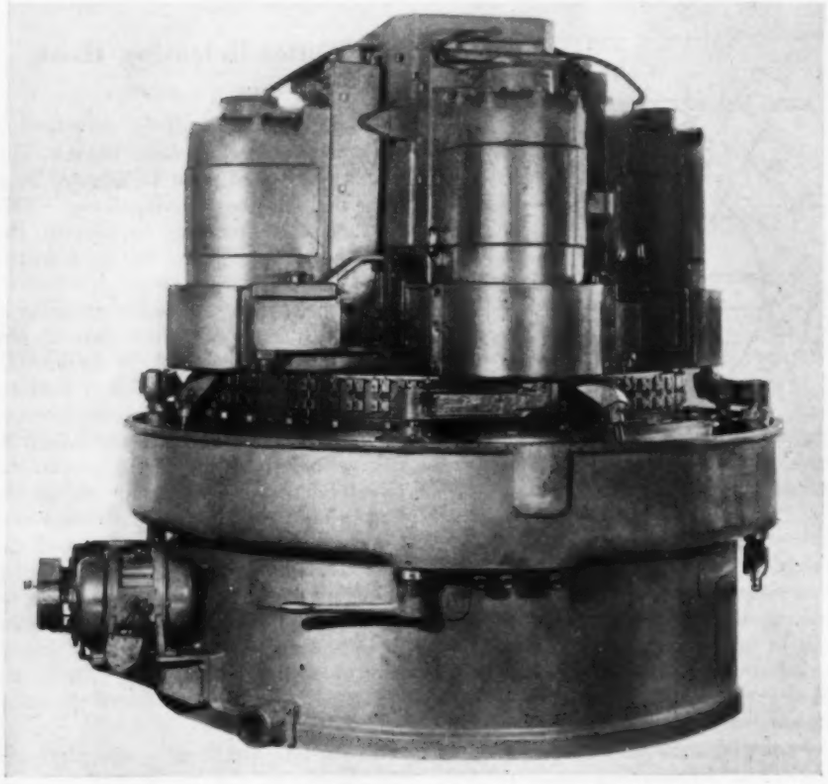
This device is used in drop-testing work in a large airplane plant. The piece to be tested must be released by a light pull on the tripping lever. This precaution is necessary to prevent the piece from tipping and falling eccentrically.

The piece to be tested by dropping is secured by any suitable means to the ring in the lower part of the device, the head on the shank of which is held by the fingers *A*. These fingers are pivoted at *B* and the upper ends are forked to receive ball bearings *C* that rotate on pins. Part *D* is a wedge for closing the fingers onto the shank of the lower ring by contact with the outer rings of the ball bearings by pressure from a spring, being normally held in the position indicated. The wedge slides on a cylindrical extension of the pivoted ring at the top of the device, being guided by a pin engaging a slot in one of the cover plates.

Pivoted to the front cover plate and connected to the guiding pin of the wedge, is the tripping lever having a ratio of 3½ to 1. A cable attached to the outer end of the tripping lever provides a means for operating the tripping mechanism from a point below.



SHOP EQUIPMENT NEWS



Rear view of Hanchett No. 72 Rotary Surface Grinder, showing the three built-in rotary drilling grinding heads

Hanchett No. 72 Rotary Surface Grinder

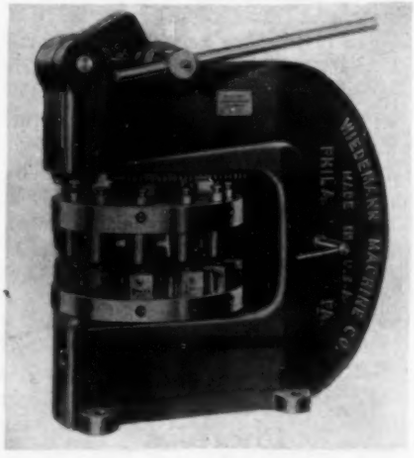
Three built-in motor-driven grinding heads are embodied in the rotary surface grinder developed by the Hanchett Mfg. Co., Big Rapids, Mich., so that the machine will perform roughing, semi-finishing, and finishing cuts on a piece without removing it from the fixture. The large circular table is made to receive various types of fixtures and rotary magnetic chucks.

The wheel-heads are mounted on a central column within the ring-type work table, to make the machine accessible from all sides. Wheelhead adjustment is the same as used formerly. The ring-type table is 72 in. diam. by 16 in. wide and is provided with three circular T-slots. It is driven by a large helical ring gear and pinion. The pinion shaft is driven from a worm gear and worm through a variable-speed drive unit and 3-hp. motor. Push-buttons are employed for starting and stopping the table, which has a speed range of ¾ to 3 r.p.m.

Grinding wheels are 18 in. in diam. Different widths of face can be supplied. Each wheel is driven by a 15- hp. motor, giving a surface speed of 5,400 ft. per min. Lubrication of the wheel spindle is obtained by pumping oil from a supply tank to a reservoir at the top of the machine, from which the oil drains to the top bearing of each grinding wheel spindle and it is piped to a sight gage at the bottom bearing of each spindle. A filter is placed in the line. Vertical feed of the grinding wheel heads is obtained automatically. Each head feeds down exactly the same amount as the wear of each wheel. If desired, the automatic control can be left off and the machine supplied with a manual control. A wheel dresser for each wheel-head is arranged so that it can be set to dress the wheel parallel with the plane of rotation. Dresser heads can be fitted with either serrated steel disks or an abrasive wheel.

Wiedemann 12-In. Throat Turret Punch

Greater throat depth and a new type lever mechanism are embodied in the 12-in. throat turret punch manufactured by the Wiedmann Machine Co., 1815-31 Sedgley Ave., Philadelphia, Pa. This bench machine has twelve punches and dies up to 1-in. diameter mounted in a revolving turret. A positive indexing device locks the revolving turret when the punch and die selected for use are located centrally under the ram. The lever mechanism that operates the ram requires but one-third the effort to do the same work, doing away with the



clumsy extension lever handle. With a pressure of 140 lb. on the 30 in. handle, the punch will punch any material within its capacity. For light work and quick handling this handle can be set to 24 in. long. Capacity of the machine is 15,000 lb. pressure and it will punch holes up to ⅜ in. in ¼ in. machine steel or up to 1 in. in ⅛-in. machine steel. Principal specifications are as follows: Clearance between dies and strippers, 7/8 in.; length of machine, 25½ in.; width, 12 in.; height, 23 in.; net weight, 420 lb.

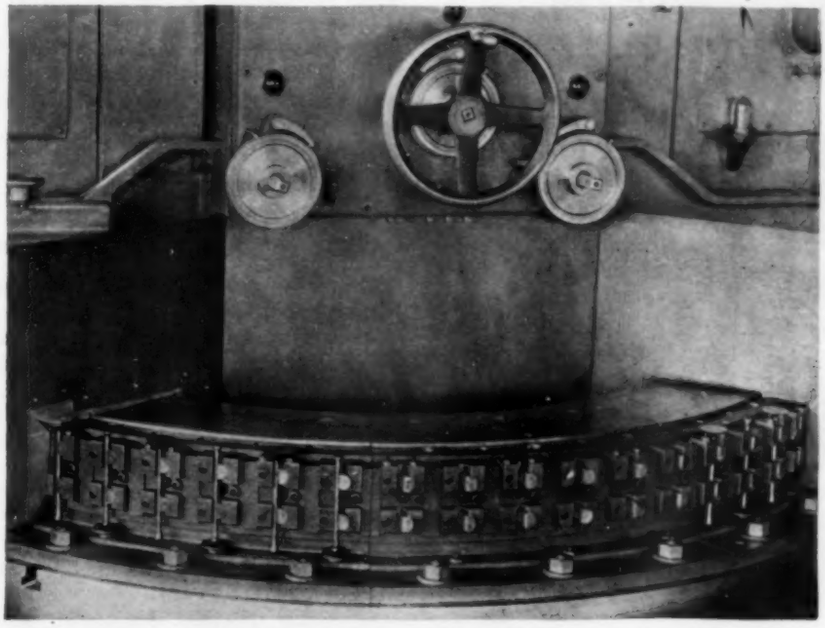
Millholland Motorized Speed Reducers

Ability to use a standard motor without special bearings, shafts or end bells is the feature of the motorized speed reducers developed by the Millholland Corporation, 1145 E. 22d St., Indianapolis, Ind. This is accomplished by bolting the reducer case directly onto the machined register of a standard motor end bell.

The speed reducers are of the worm and worm gear type, anti-friction bearings supporting the worm and worm gear. The design provides for an outboard foot support to the reducer. Hollow levelling thimbles, through which the reducer hold-down screws are placed, are provided in the outboard-support feet to accommodate variations in the center height of the motors. The output shaft is made to project in any one of four positions in two planes, and the position may be changed without the use of special tools. Air vents in the reducer case at the motor end allow the motor to receive cooling air. Sizes are available to fit all standard motor frames from ¼ to 10 hp.

New Carboloy Prices

According to an announcement by the Carboloy Company, Inc., 2481 E. Grand Blvd., Detroit, Mich., a price reduction on Carboloy cemented carbide becomes effective after June 30, 1932. Blanks and tools, of any design, any size or in any quantity, are now available at the new rates.

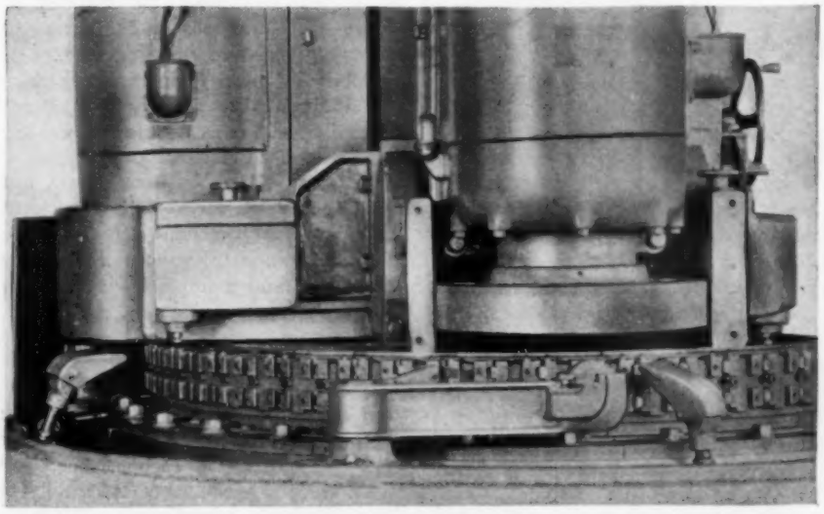


Close-up of the Hanchett surface grinder, showing a valve fixture in position. This fixture is designed with a series of spring plungers operating through hardened V-blocks so as to lock the stem of the valve into the V

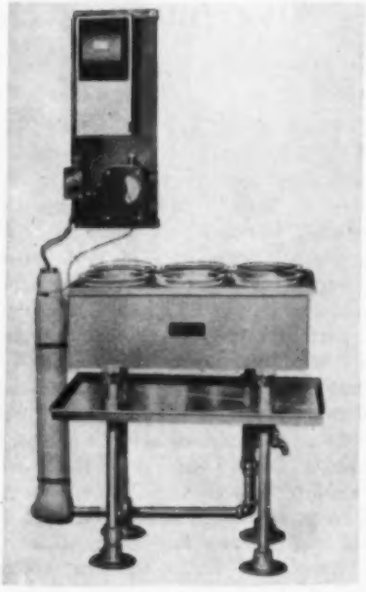
Divine Bros. Electric Glue Heater

A thermostatically controlled electric glue heater, which maintains the temperature of the glue in the glue pots within 2 deg. F., has been offered by the Divine Bros. Co., Utica, N. Y. Tests have shown that over 90 per cent of the heat evolved is absorbed by the glue. In addition, the time required for preparation of the glue is materially reduced. After the glue has reached the correct temperature of 135 deg. F., the current is automatically cut off, and will remain off until the temperature has dropped 2 deg.

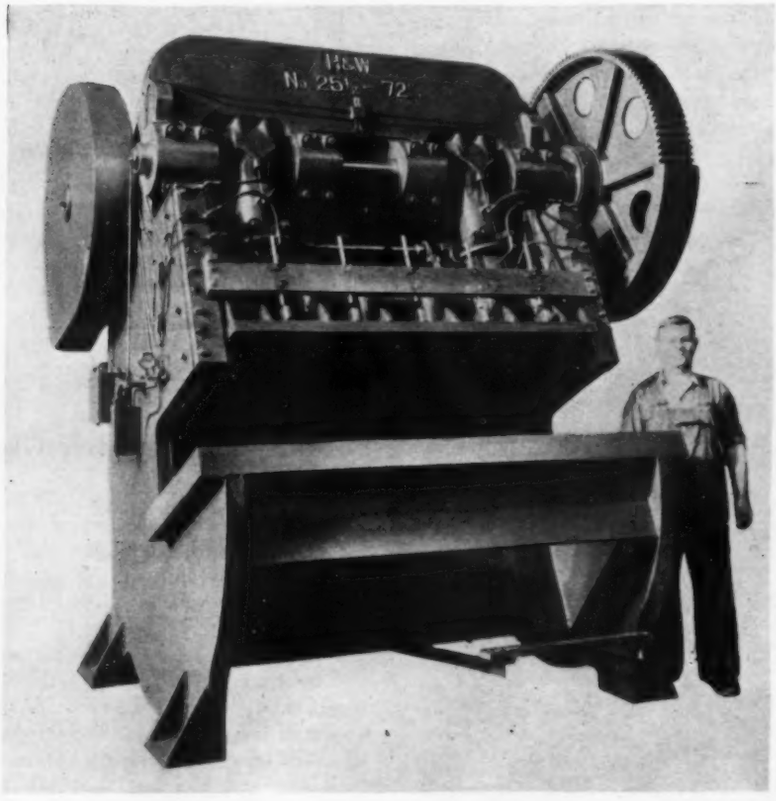
The bath consists of a copper tank,



Close-up of the wheel dresser and location of three automatic sizing or gaging devices. These gages are mounted on a vertical slide on the side of the wheel guard. The gages operate through electric controls so as to operate the wheel-feed screws



insulated with an aluminum top that is highly polished to reduce radiation loss. A time control can be supplied to switch on the electric current at any time for which it may be set. This is of value at the starting time in the morning. The heater is made with 4, 6 or 8 pots, the pot capacity being 2, 3, 4, 6, or 8 quarts, as desired in each type. Current required to maintain glue temperature is small.



Henry & Wright No. 25½ Welded-Steel Overhanging Double-Crank Press

Typical of its line of welded steel presses is No. 25½ overhanging double-crank press recently completed by the Henry & Wright Manufacturing Co., Hartford, Conn. This machine is inclined in a fixed position of 25 deg. from the vertical so that large blanks, such as automobile running boards and similar parts produced in compound dies, will slide by gravity to a conveyor mounted at the rear. The frame, slide and main gear are of welded-steel construction normalized after welding to eliminate stresses set up in the rolling or welding processes.

The press throat is inclined with respect to the center line of the slide and has large radii at the top and bottom to reduce stress concentrations. Welded-steel ribs are employed in the frame.

The crankshaft is mounted in bronze-bushed bearings and the welded-steel slide is guided in bronze-lined ways. Gibs are of alloy iron. The drive shaft is equipped with Timken roller bearings. Automatic pressure lubrication is supplied to all principal bearings, and the amount of lubricant to each can be adjusted to suit, while the time period may be varied from every 7 to 60 minutes.

Major dimensions of the No. 25½ press are: opening, 72 in.; area of bed, 30 x 85 in.; opening in bed, 15 x 56 in.; area of slide face, 24 x 66½ in.; shut height, bed to slide, 15½ in.; thickness of bolster, 3½ in.; stroke, 4 in.; number of strokes per minute, 35; ratio of gearing, 7½ to 1; net weight, 30,000 lb.

Widia Prices Reduced

Thomas Prosser & Son, of 15 Gold Street, New York City, American representatives of Fried. Krupp A. G., Essen, Germany, announce a general price reduction on all Widia cemented carbide tools and tips, effective July 1st, 1932. The reductions run from 10 to 50 per cent on various tools, depending primarily on the size of the tip used. Base prices of the Widia tips themselves have been reduced from 10 per cent on the smallest tips to 40 per cent on the largest tips. The labor charges for manufacturing tools have also been considerably reduced. Thomas Prosser & Son are also inaugurating a new service, namely the supplying of "milled and brazed" tools. These tools are furnished brazed complete ready for grinding, which can easily be done by the customer.

Colmonoy Crystal Products

Colmonoy crystals, free from carbon and tungsten, form the base of the nine Colmonoy products now offered by the Booth Engineering Company, Limited, 15 Park Row, New York, N. Y. The Colmonoy inserts consist of the crystals in a matrix of tungsten, and as a substitute for diamonds, can be used to advantage on various types of cutting tools. The inserts do not oxidize or crack when heated to a high temperature, and their hardness lies between nine and ten on Moh's scale.

Colmonoy granules have the same composition as the inserts, range from 16 to 60 mesh and are applied to thin-edged tools such as shovels, by spreading them thinly on the surface by the oxacetylene flame until the granules are cemented to the base metal, giving an extremely abrasive resisting edge.

Colmonoy hard facing rods come in two different types. The No. 1 rod, applied by either gas or electric welding, makes a hard facing for general all around use. The No. 6 rod has a high crystal content in a matrix of iron, nickel and molybdenum. Though not as hard, it is more abrasion-resisting than No. 1 rod, and is applied with the oxy-acetylene torch.

Colmonoy overlay compound is for carbon arc application only, giving an extremely hard and abrasion-resisting overlay. Spread evenly over the surface to a depth of about ⅛ in., and fused in with a small sharp carbon pencil, one layer gives a hardness of Rockwell C62 to C66, while two layers will give a hardness ranging from C65 to C69. Colmonoy machine tool overlay is for tipping lathe tools by welding on from the rod form with the oxacetylene torch.

"Eraydo" Zinc Base Alloy

A patented zinc-base alloy, containing about one per cent copper and a fractional per cent of silver, is being marketed under the trade name of "Eraydo" by Illinois Zinc Co., 332 S. Michigan Ave., Chicago, Ill. It has a tensile strength about twice that of common zinc, and with an annealing, or recrystallization, temperature of from 300 to 450 deg. F., depending on temper, instead of the low room-temperature figure of pure zinc. It is produced in sheet and strip form in four tempers or grades of hardness. The softest temper has the ductility of pure zinc with a 50 per cent increase in tensile strength. Harder tempers with somewhat less ductility reach a tensile strength value equal to twice that of common zinc.

Its increased hardness results in a beautiful chromium-like luster after buffing; and clear lacquer coatings have been developed which preserve this finish for long periods.

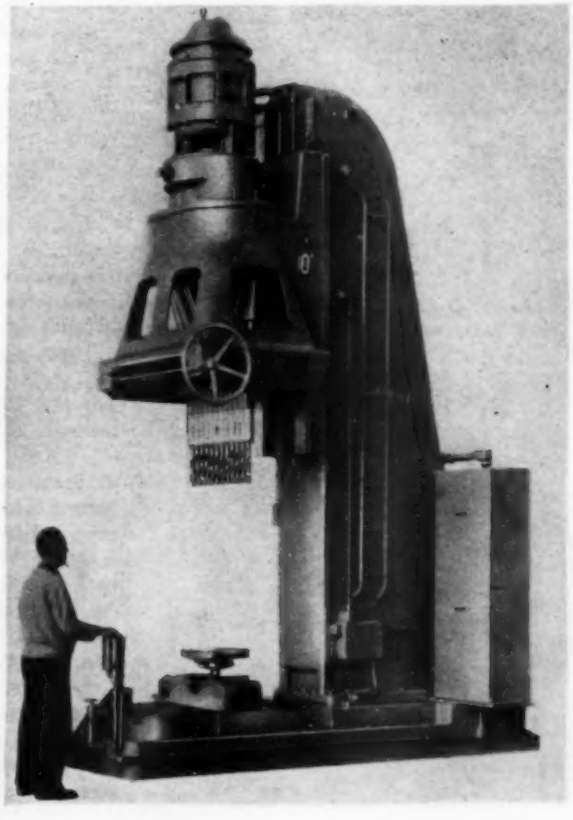
The metal casts well either in sand or by die casting. Aluminum has been purposely excluded, in order to avoid intercrystaline oxidation and swelling in moist temperatures. Therefore, the metal must be die-cast in a machine in which there is no opportunity for iron pick-up by the molten metal. Test bars, die-cast, give an impact value of over 400 lb. per sq.in. (Charpy ¼ in. square specimen).

The metal performs well in common manufacturing operations. It is easily plated, soldered, forged, drawn and spun. It is supplied in rod or wire form in either a free cutting grade or a tough condition which is used for cold heading work.

Natco Hydraulic-Feed Multiple-Spindle Drilling Machine

A large multiple-spindle hydraulic drilling machine to be used to drill tube holes in large express-type boiler drums has been developed by the National Automatic Tool Co., Richmond, Ind. The machine is equipped with a semi-automatic Oilgear feed arranged with a safety foot-control and emergency reverse. The unit is equipped with a 24x40-in. rectangular head bored for 16 spindles and with twelve 3-in. upper joint assemblies, each having a single speed and neutral position. Roller bearings are used throughout the head. The spindle equipment consists of a special adjustable bearing plate arranged for and complete with twelve 2⅝-in. spindles having No. 4 Morse taper and nose adjustment. These twelve spindles are held in a straight line parallel to the ways on the column and have a horizontal adjustment toward and away from the column of 14 in. Minimum distance is 22 in.

A special base is provided with two rectangular slots running from left to right, and these are of proper depth to insert a 75-lb. rail. The slots are spaced to permit a 36 in. center-to-center spacing of the rails under the center of the head. Coolant is supplied to the work by means of an independent motor-driven pump at the rear of the column. Mounted on the base between the two large slots is an air-operated jack, which is used to support the large steel drums while they are being drilled. Weight of the machine is 38,000 lb., and the capacity is twelve 1½ in. holes in steel at heavy feed.



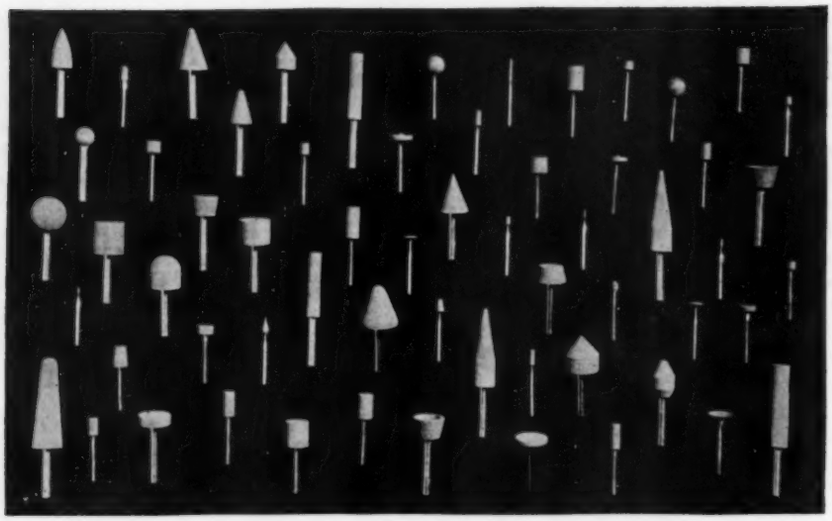
"Gold Flash" Singlelift Truck

Reduced headroom and a high-capacity release check used to govern the load in lowering are features of the

"Gold Flash" single-lift truck announced by the Lewis-Shepard Co., Watertown Station, Boston, Mass. Capacities up to 5,000 lb., widths of 17½ or 24 in., and lifts of 1⅝ or 2¼ in. are available in these trucks. When in the load raising position the handle is always connected to the load. To release the load from the elevated position, the operator presses the release pedal and the lock rolls out of engagement without jolting. In descending, the load moves forward and downward at the same time, and does not interfere with material stacked behind it.

Norton Wheels and Points

Wheels, points, pencils, buttons and other shapes have been placed on the market by the Norton Co., Worcester, Mass., the line including 100 different shapes which can be used on standard machines. They range from points 1/32 in. in diameter to wheels 1 in. in diameter. Most of the products are made of 38 Alundum abrasive, developed expressly for tools and die work. For

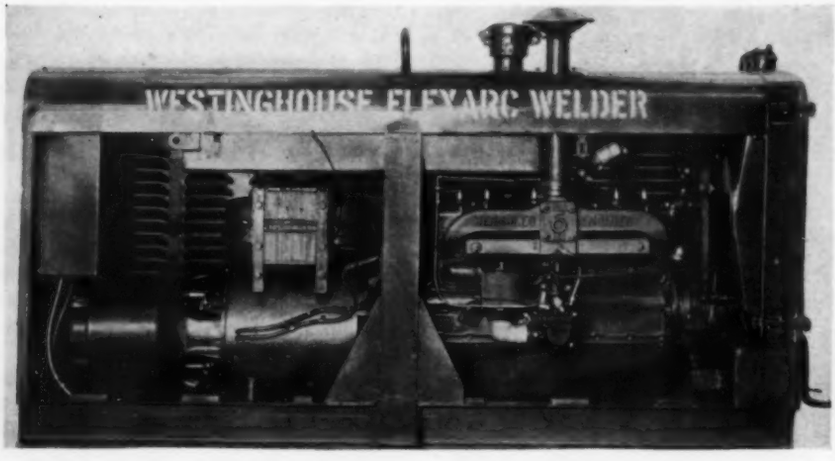


production grinding of small holes most of the mounted wheels are made of regular Alundum abrasive, and for non-ferrous and non-metallic work there are Crystolon abrasive points and grinding wheels.

The spindle is made of special steel first coppered and then nickel plated. It is knurled and designed with a chisel end to insure permanent anchoring of the abrasive on the quill. A special cement is used. Generally speaking, the points and wheels are made with vitreous bonds, some of them of the "B-Bond," but there also are Bakelite bonded points or wheels for specific purposes.

"Flexarc" Gas-Engine Welders

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has developed 300- and 400-amp. gas-engine-driven "Flexarc" welders which embody: canopy protection from weather, accessible controls, transformer-type reactance to prevent current surges and electrode sticking, 6-in. rim, steel-tired wheels or smaller-type shop wheels, or pneumatic or solid-tired wheels. Exciters can be furnished to operate small portable tools.



"Rightway" Screw, Nut and Stud Driver

A flexible-shaft type of screw, nut and stud setter has been introduced by the Foster Machine Co., Elkhart, Ind., under the trade name of "Rightway." The unit may be suspended from the yoke or placed on a pedestal. Driving tension is quickly adjusted and remains uniform. The socket end of the flexible shaft is provided with a push-button control so that the 220- or 440-volt, a.c. polyphase motor may be disconnected after the stud or nut is driven home.

Where the driving device must be mounted directly above the work, a telescoping sleeve is furnished on the spindle. The sleeve has a 6-inch travel and the operator simply lowers and raises the sleeve to the work while the weight of the driving unit is supported from above.

Oxweld Type W-22 Welding Blowpipe

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., has announced a welding blowpipe, designated as the "Oxweld" Type W-22. Although it has been developed primarily for use on pipe line work, its application is not restricted to this field.

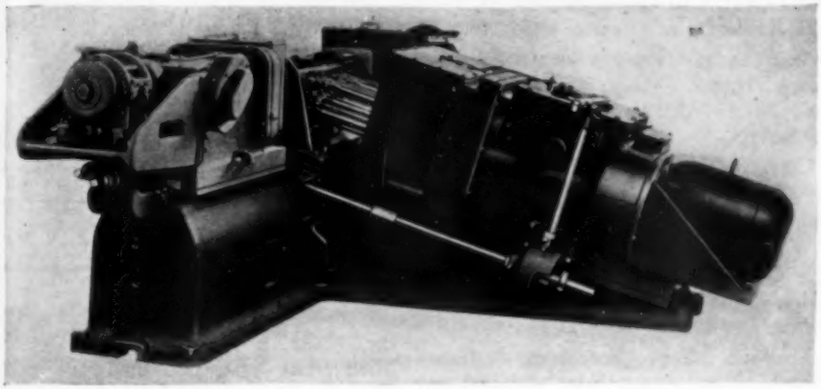
The blowpipe is very similar to the Type W-17 welding blowpipe, except that the oxygen and acetylene valves are located on the front of the handle, so that flame adjustments may be made more readily by the operator while the blowpipe is in operation. Since it is preferable to control flame adjustment by means of the acetylene valve, this valve is located on the left side of the front of the handle where the operator's right thumb can conveniently regulate it. The oxygen valve is located on the under side of the handle where it may also be easily reached. The long acetylene passageway between the acetylene valve and the injector minimizes the possibility

of flashback. This is accomplished by having three acetylene tubes between the rear and front bodies.

Oxweld Type W-17 welding heads, both one-piece and detachable tip, are used with the Type W-22 blowpipe, and the Type CW-17 cutting attachment, the W-17 to W-15 adaptor and extra-long Type W-17 welding heads may also be used on the W-22 handle, so that the blowpipe covers exactly the same range of work as the Type W-17 welding blowpipe.

Foote-Burt Three-Way Drilling Machine

Illustrated is a rear view of a three-way, 39-spindle drilling machine recently built by The Foote-Burt Company, Cleveland, Ohio, for use in drilling the bottom and ends of automobile cylinder heads. The side heads each have 4 spindles and are driven by 10 in. diameter cam units. The rear head has 31 spindles and is driven by a 14 in. diameter cam unit. Each of the units is complete within itself and has individual motor drive. The main lever is used for starting the cycle, and each head goes through the cycle and returns to the starting point, where it remains until the lever is again operated. Holes drilled by the rear unit are rather deep, and consequently this unit is placed at a 10-deg. angle to aid in the removal of chips.



Gasoline Portable "Togglebug" Drill

For drilling holes in shapes and in plates, slabs or timbers away from electric power, the gasoline portable "Togglebug" drill has been developed by the Gubert Steel Co., Pittsburgh, Pa. It is of the same design as the electric "Togglebug" drill, with the exception that gasoline power is furnished. The machine will drill, ream, or countersink. It has spindle speeds of 250 to 600 r.p.m. and can drill 1½ in. holes and smaller through 1¤ in. of metal. It can be transported by a crane, rolled along on its rollers or carried by three men. In addition auxiliary wheels and axles can be furnished for towing.

Power is furnished by a 6-hp. gasoline motor. Coolant is applied at the drill point from a tank mounted on the machine. A system of weights and counterweights give the Togglebug the necessary pressure required for drilling large holes. By sitting or leaning on the end of the 5-ft. handle, the operator can exert a tremendous pressure on the drill point. The frame, in addition to the rollers, rests on adjustable legs which permits drilling a vertical hole in materials of different thicknesses and also permits getting the drill close to flanges in webs of large beams and H-sections.

Lincoln "Shielded Arc" Welder

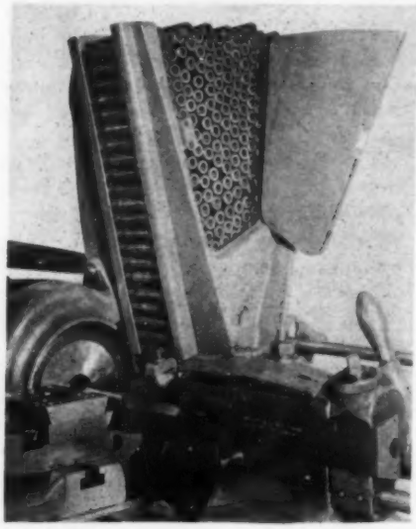
The Lincoln Electric Co., Cleveland, Ohio, has announced a "Shielded Arc" welder with uniform welding current. It is claimed to allow the use of a higher average current per size rod, which permits increase in the speed of welding and the amount of weld metal deposited. The welder is rated at 40 volts instead of the former 25, and the kilowatt rating has been increased 60 per cent.

The welder is equipped with dual control and is also equipped with a reversible voltage control because of the reversed polarity required with shielded arc welding. The reversible voltage control eliminates the shifting of cable connections. A center-reading volt-ammeter is mounted on the control panel to indicate whether the machine is operating with positive or negative polarity as well as to show the volts and amperes. The control panel has a dead front and no exposed live connection in either the front or the back. The upper half of the welder is entirely inclosed to make it drip-proof and thus prevents injury from anything dropped upon it. Arc-welded steel construction is employed. The welders are built in a.c. and d.c. motor-driven types of 300, 400 and 600 amp. sizes. Removable running gear and draw bar makes a change from portable to a stationary model possible.

Magazine for Pratt and Whitney Automatic Lathe

To increase the loading capacity of the 1 x 18 in. full automatic lathe, the Pratt & Whitney Co., Hartford, Conn., has developed the magazine illustrated. It is shown set-up for a cast-iron automotive valve-stem guide. Three hundred pieces comprise the full load. This represents about 75 minutes of work, as the valve stems are machined in 15 seconds each.

With the new magazine the operator can handle several more machines than with the smaller type of magazine, thus



reducing labor cost per piece from 30 to 45 per cent. As shown, the magazine has a hinged door on one side to facilitate loading. The work is placed with corresponding ends all one way.

Exhaust System for "Standard" Grinder

In connection with its companion grinding and buffing machine, the Standard Electric Tool Co., 1938 West Eighth St., Cincinnati, Ohio, has developed an exhaust blower system. Both the grinder and buffer sides of the machine

are fitted with inclosed hinged door guards, each having an exhaust outlet. On the back of the pedestal is mounted a ¾-hp. 3,600-r.p.m. motor-driven exhaust fitted with a dust-collecting bag. This arrangement eliminates the necessity for installing an elaborate exhaust system and provides a complete assembled unit.

• PATENTS •

JUNE 21, 1932

Metal-Working Machinery

Machine for Cutting Threads and Cutting Teeth in Bodies. Ernest J. Lees, Cleveland, Ohio, assigned to The Lees-Bradner Co. Patent 1,863,570.

Machine and Process for Generating Gears. Ernest J. Lees, Cleveland, Ohio, assigned to H. T. Bradner. Patent 1,863,571.

Centerless Grinder. William H. Chapman, Montclair, N. J., assigned to General Motors Corp. Patent 1,863,832.

Work Support for Machine Tools. Max E. Lange, Cleveland Heights, Ohio, assigned to The Warner & Swasey Co. Patent 1,864,046.

Machine Tool Structure. Hans Fritschi, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,864,129.

Machine for Threading Bolts and the Like Objects. Harry C. Ellison, Lakewood, Ohio, assigned to Republic Steel Corp. Patent 1,864,235.

Chip Remover and Water and Dust Seal for Machine Tools. Ernest H. Johnson, Bridgeport, Conn., assigned to The Bullard Co. Patent 1,864,307.

External Grinder. Clifford T. Raule, Brookline, Pa. Patent 1,864,320.

Feed Mechanism for Broaching Machines. Louis Sandler, New Castle, Pa., assigned to Johnson Bronze Co. Patent 1,864,322.

Art of Grinding. Sol Einstein, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,864,486.

Tools and Attachments

Indicator Jaw Gage. Alexander Schraven, Essen, Germany, assigned to Fried. Krupp Aktiengesellschaft, Essen-on-the-Ruhr, Germany. Patent 1,863,673.

Die Holder. Albert Rafter, Belleville, N. J., assigned to Rafter Machine Co. Patent 1,863,729.

Method of Packing Die Sets. Emil A. Baumbach, Chicago. Ill. Patent 1,863,894.

Means for Removing Lubricating Compound from Perforated Sheet Metal. William J. Purser, Mineral Ridge, Ohio, assigned to Bostwick Steel Lath Co. Patent 1,864,257.

Chuck. Paul Forkardt, Dusseldorf, Germany. Patent 1,864,423.

Tool Holder. John N. Peterson, Milwaukee. Oreg. Patent 1,864,466.

Processes

Method of Annealing Nitrided Steel. William J. Merten, Pittsburgh, Pa., assigned to Westinghouse Electric & Manufacturing Co. Patent 1,864,083.

Method of Continuous Centrifugal Casting. Richard H. Eurich and Benjamin F. Anthony, Youngstown, Ohio, assigned to The Youngstown Sheet & Tube Co. Patent 1,864,270.

Method of Forge-Welding Stellite. Ole Severson, Shelton, Conn., assigned to The O. K. Tool Co., Inc. Patent 1,864,497.

• TRADE PUBLICATIONS •

CARBOLOY TOOLS. The Carboloy Co. Inc., 2481 E. Grand Blvd., Detroit, Mich., has just published the 1932 "Handbook and Catalog of Carboloy Tools," which contains an extensive section devoted to the manufacture, design, operation and maintenance of such tools, and a supplementary section containing a listing of other tool manufacturers licensed to supply tools equipped with the cemented carbide.

ELECTRICAL APPLIANCES. The National Board of Fire Underwriters, 270 E. Ohio St., Chicago, Ill., has available "List of Inspected Electrical Appliances" as of April, 1932.

FILTERS. "American Air Filters in Industry," a new booklet by the American Air Filter Co. Inc., Louisville, Ky., treats of industrial dust problems and filtered air and how filtered or conditioned air is applicable in processes and the maintenance of plant equipment.

HEAT-TREATMENT SERVICE. American Metal Treatment Co., Spring, Lafayette and Elizabeth Sts., Elizabeth, N. J., has issued a circular on its heat-treating service.

PUMPS. Geo. D. Roper Corp., Rockford, Ill., has issued a folder showing all types of hand- and power-driven rotary pumps manufactured. A score or more models are illustrated.

REBUILT MACHINE TOOLS. List No. 81 has been issued by J. L. Lucas & Son, Inc., Bridgeport, Conn., on rebuilt metal-working machinery. The bulletin contains 33 6x9-in. pages.